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OBSERVATIONS ON THE INFLUENCE OF THE PHILIPPINE CLIMATE ON WHITE MEN OF THE BLOND AND OF THE BRUNETTE TYPE.[1]

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(From United States Army Board for the Study of Tropical Diseases.)

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PART I. INTRODUCTION; SOURCES OF EVIDENCE; GEOGRAPHY AND CLIMATE; SUNLIGHT.

INTRODUCTION.

The influence of a tropical climate on men, especially the members of the Caucasian race, is an extremely complex subject. Among the general factors to which, with greater or less weight of authority, the deleterious effects of tropical residence are alleged to be due may be mentioned heat, humidity, chemical action of the sunlight, lack of exercise, disturbed sleep, improper food, bad water, alcoholic and venereal excesses, and, perhaps most important of all, infections with those animal and vegetable pathogenic organisms which are confined more or less exclusively to hot regions. Individually age, sex, race, stature, previous residence, personal immunity, and perhaps complexion have to be given consideration.

The work herein reported has to do with only one of the above factors, namely the complexion type. The distribution of the black and brown races in the hotter portions of the globe and the difficulties which in the past attended the colonization of the Tropics by the Caucasian were matters of common observation long before the causes of tropical disease and deterioration received any adequate study. More recently several authors have claimed that the blonds tend to decrease in numbers or to deteriorate when they are transplanted from the relatively cloudy regions of northern Europe to sections in the Temperate Zone which have a much greater amount of sunshine. Woodruff, studying this phase of the subject in the Philippines, maintains that the blonds suffer more severely than do the brunettes from the deleterious influence of tropical residence and that the ill effects observed among white men dwelling in the Torrid Zone are due mainly to the large proportion of chemical or ultra-violet rays contained in the tropical sunlight.(2) (3)

To determine what may be the influence of the actinic rays alone, as distinguished from the other factors enumerated in the first paragraph, is evidently well-nigh impossible. The question as to whether transplanted fair-skinned races gradually change after many generations from a lighter to a darker average type, as a result of the survival of those best fitted to endure a high degree of sunlight, is purely speculative and of theoretical interest only. Whether men of dark complexion living ten, twenty, or thirty years in the Tropics can withstand the climatic influences more successfully than those having fair skin, light hair, and blue eyes is of much practical importance, but is extremely difficult to determine because of the almost insurmountable obstacles which stand in the way of making observations over such a period of time on any considerable group of men. When it comes to the relative resistance of the blonds and the brunettes during the comparatively short tour of duty (two years) which American soldiers commonly serve in the Phil-

ippines, the task is beset with fewer difficulties and it is to the elucidation of this problem that our efforts have been directed during the last thirty months. The matter is of some practical importance in the selecting of recruits and civil service employees for tropical countries.

SOURCES OF EVIDENCE.

The evidence on which this report is based is of several kinds and derived from various sources. It may be divided into classes as follows:

CLASS I. A series of observations carried out under the supervision of the Board, during the calendar year 1909, on enlisted men of the United States Army. This will be called the "1909–Group." One hundred and fifty-seven blonds and 154 brunettes were observed. Besides the symptomatology and the sick record over a period of two years for these men, there were made 1,100 weight, 1,320 pulse rate, 1,320 respiration rate, 1,320 temperature, 880 blood-pressure and 880 dynamometer observations, spaced at equal intervals throughout one year.[3] There were performed by the Board 195 red blood cell counts, 195 hæmoglobin estimations, 38 leucocyte counts, and 57 differential counts.

CLASS II. A series of observations carried out under the supervision of the Board during the calendar years 1910 and 1911 on enlisted men of the United States Army. This will be called the "1910–Group." Three hundred and forty-seven blonds and 346 brunettes were observed for one year. Besides recording the sick record,[4] symptoms, effects of tropical residence and sunlight, habits as to food and alcohol, characters, court-martial trials, fines and confinements, there were made on the men, 3,694 weight, 3,986 pulse rate, 3,986 respiration rate, 3,986 temperature, 2,540 blood-pressure and 620 dynamometer observations, 1,134 hæmoglobin estimations, 1,134 red blood cell counts, 1,152 urine and 601 stool examinations.[5] These observations were spaced at regular intervals throughout a year. There were performed by the Board 118 leucocyte estimations, 90 differential blood counts, and 56 Arneth counts on blond and brunette Americans, and, for comparison, 552 blood-pressure estimations on 386 Filipinos and 50 differential and Arneth counts on 50 Filipinos.

CLASS III. A collection of data from the commissioned officers of the Philippine Scouts and the Philippines Constabulary and from the Americans in the Manila police force. These are men who have been a long time in the Philippines, the average period of continuous tropical service being 5.5 years. There were 186 blonds, 147 brunettes, and 235 of a mixed type in this group. As a class they are men who do a large amount of work out of doors and exposed

[3] The observations referred to in this sentence were made under the supervision of the Board, by the following medical officers of the United States Army: Major C. C. Collins and Captains C. D. Cowles, jr., G. L. McKinney, and H. A. Phillips.

[4] The sick record covered a period of over twenty-two months.

[5] The observations referred to in this sentence were made under the supervision of the Board, by the following medical officers of the United States Army: Majors A. E. Truby and Roger Brooke, jr.; Captains E. G. Bingham, John R. Barber, Mahlon Ashford, E. G. Huber, H. M. Snyder, and W. L. Hart; First Lieutenants J. B. H. Waring, W. R. Dear, C. E. Doerr, F. S. Wright, C. G. Snow, N. L. McDiarmid, Armin Mueller, T. J. Leary, M. C. Stayer, L. C. Garcia, and C. E. Fronk, Medical Corps; and First Lieutenants W. F. de Niedman and C. A. Betts, Medical Reserve Corps.

to the sun. These individuals are considered in what we will term the "Scout–Constabulary–Police–Group."

CLASS IV. An examination of all patients invalided home from the Division Hospital in Manila during a period of one and one-half years and a determination of the complexion type of each. There were 273 of these men.

CLASS V. An examination of 10,072 enlisted men of the United States Army to determine the relative proportions of the blond, brunette, and mixed types. The rate per 1,000 was found to be, blonds 238, brunettes 206, mixed types 556. This information was used as a basis for comparison with the rates per 1,000 of the three types in Classes III and IV, the former consisting of men who had voluntarily endured the climate for an average of 5.5 years and the latter of men who had succumbed to its influences during their tour of military service.

CLASS VI. A series of cases of sunstroke and heat exhaustion occurring in the United States and in which the type of complexion of the patient was recorded.[6]

In Class II, the choice of the blonds and brunettes for observation was made by the medical officers referred to in footnote 5, and the selected men were subsequently all examined by the writer, and those who did not conform to the standard types were excluded. In Class I, selection was made by choosing from the cards of a group of 800 men, who had been under observation for two years, those on which the 3 recorded complexion factors indicated well marked blondness or a clearly defined brunette type. Throughout this report the blond group includes men with blue or gray eyes, light brown, red, flaxen, or sandy hair, and fair, ruddy, or light complexion, while the brunette group is made up of those with brown or black eyes, dark brown or black hair, and medium or dark complexions. Men in whom one of the complexion factors corresponded to a certain type and the other two belonged to the opposite type were classed as "mixed," and were excluded from the observations dealt with in Part II.[7]

Each of the officers referred to in footnotes 3 and 5 had under ob-

[6] These statistics were collected through the kindness of the authorities at the following hospitals, to whom we wish to express our appreciation of the courtesies extended to us: Philadelphia General Hospital; Roosevelt Hospital, New York, Bellevue Hospital, New York; Massachusetts General Hospital, Boston; Presbyterian Hospital, New York; Boston City Hospital; Carney Hospital, Boston; St. Luke's Hospital, Chicago; Mercy Hospital, Baltimore; Jefferson Hospital, Philadelphia; New Haven Hospital; Alexian Brothers' Hospital, Chicago; Cook County Hospital, Chicago; St. Louis City Hospital; Rhode Island Hospital, Providence. We also received reports from a few other institutions, but as they came in our franked envelopes without address we are unable to credit them to the sender.

[7] With such a classification there will be a very well marked average difference in complexion type between the blond group and the brunette group. However, it must not be thought that all of the blonds were conspicuous examples of blondness. A man with dark blue eyes, light brown hair, and a fair skin would fall in the blond class and, while not a conspicuous blond, would still be sharply contrasted with the man of dark brown eyes, black hair, and swarthy complexion.

servation approximately equal numbers of the blonds and of the brunettes, and therefore in considering the final results the personal factors of the different observers need not be considered. The conditions under which the men of the blond and of the brunette type lived during the observation period were identical in all known respects.

GEOGRAPHY AND CLIMATE OF THE PHILIPPINES.

The observations were made at various localities in an Archipelago consisting of many hundreds of mountainous islands extending in latitude from 21° north to 5° north. No point even in the larger islands is in excess of 100 kilometers from the sea. With the exception of Camps Stotsenburg, John Hay, and Keithley, all of the military posts where the observations were conducted are located on or close to the coast-line and elevated but a few meters above the sea level.[8] Camp Stotsenburg is located about 50 kilometers from salt water on a plain at an altitude of about 200 meters. Its climate does not differ materially from that of the coast stations. Camp John Hay and Camp Keithley are in the mountains at altitudes of 1,500 and 800 meters respectively, and are characterized by a much lower temperature and a higher degree of cloudiness than are the lowland stations. The observations made at these two posts are not included in the general averages and were used merely for comparison with the lowland groups.

Although everywhere tropical yet the climate of the Philippines varies considerably in different localities as a result of altitude, influence of mountain ranges, and proximity to the sea. In the regions where most of the observations were carried out the hot and dry season is in April, May, and June. The rains come with the cessation of the northeast monsoon in June or July and persist till October or November. The differences in temperature between the warm season and the cool season are quite noticeable. In the posts in Mindanao and Jolo the differences of season, as regards both temperature and rain, are less clearly marked, and, as a result of several factors, the heat is no greater than on the northern coast of Luzon, over 1,200 kilometers more distant from the Equator, and indeed is less intense than in many of the central parts of the Archipelago.

Complete details as to the climate of the Archipelago can be obtained from Bulletin No. 2, Census of the Philippine Islands, entitled The Climate of the Philippines. A few figures are collected from this publication to show the more important climatological features at different points.

[8] Fort William McKinley and Camp Jossman are each about 7 kilometers inland, but are little elevated above the sea. Fort Mills is on an island about 2 kilometers wide, but its highest ridge, where the barracks are located, is 200 meters above sea level.

TABLE I.—*Annual thermic oscillation in the Philippine Archipelago.*[a]

Place.	Annual oscillation.		Latitude (north).		Place.	Annual oscillation.		Latitude (north).	
	°C.	°F.	Degrees.	Minutes.		°C.	°F.	Degrees.	Minutes.
Aparri	6.5	11.7	18	22	Iloilo	3.8	6.8	10	42
Tarlac	5.2	9.4	15	31	Ormoc	2.8	5.0	11	00
Arayat	4.6	8.3	15	8	Cebu	2.7	4.9	10	18
Manila	3.5	6.3	14	35	Davao	2.2	4.0	7	1

[a] This indicates the variation of the *mean* monthly temperature and not the *extreme*.

For Manila, which is representative of most of the region under consideration in this report, the normal monthly means of temperature for the period 1883–1902 are shown in Table II. The maximum recorded temperature in Manila (May, 1889) was 37°.8 C. (100° F.), and the minimum (Jan. 1907) was 15° C. (59° F.).

TABLE II.—*Normal monthly means, Manila.*

Month.	°C.	°F.	Month.	°C.	°F.
January	25.0	77.0	July	27.1	80.7
February	25.4	77.7	August	27.1	80.7
March	26.8	80.2	September	27.0	80.6
April	28.3	82.9	October	26.9	80.4
May	28.6	83.4	November	26.1	79.0
June	27.9	82.2	December	25.2	77.3

The rainfall for the sections where the blond-brunette observations were being carried out ranges from 205 to 256 centimeters per year.[9] The degree of cloudiness is of much importance in an observation having to do with the possible influence of tropical light. The average cloudiness for Manila is given below, the scale being from 0 for a clear sky to 10 with the sky entirely covered. The table also shows the average of clear and variable days and the average hours of sunshine.

TABLE III.—*Average cloudiness, average clear and variable days, and average hours of sunshine monthly in Manila.*

Month.	Average cloudiness.	Average clear and variable days.	Average hours of sunshine.	Month.	Average cloudiness.	Average clear and variable days.	Average hours of sunshine.
January	4.6	23.9	193	August	7.5	14.0	143
February	3.8	23.8	220	September	7.4	13.1	135
March	3.8	23.9	247	October	6.1	17.1	172
April	3.5	25.1	264	November	5.8	18.6	160
May	5.1	19.9	220	December	5.6	22.6	157
June	6.8	17.3	160	Mean	5.6	19.5	184.8
July	7.5	14.9	147				

[9] This does not include Camp John Hay and Camp Keithley where the rainfall is much higher.

Comparing the average number of hours of sunshine with the figures for certain places in the United States it will be found that Manila receives 51 per cent of the theoretical sunshine while New York receives 56 per cent, Chicago 57 per cent, Denver 69 per cent, and Santa Fe 76 per cent.(1) In other words numerous regions in the temperate United States are characterized by many more hours of sunshine than are the tropical Philippines. These figures of course do not take into consideration the question of intensity of the sunlight in the two zones.

The quantity of watery vapor in the atmosphere has a direct influence on the climate, because it checks to some extent the radiation of heat, and the relative humidity is of still greater importance in studying the influence of climate on man because the greater the humidity the more marked is the interference with the thermolysis of the body resulting from the evaporation of perspiration.(21) The following table shows the monthly and annual averages in Manila for a period of twenty years. These figures may be compared with average relative humidity records for July of 70.6 per cent for Chicago, 70.4 per cent for New York, 71.0 per cent for Washington, and 72.3 per cent for New Orleans.

TABLE IV.—*Monthly and annual averages of relative humidity in Manila, per cent.*

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average.
77.6	74.2	71.8	70.7	76.7	81.4	84.8	84.8	85.5	82.7	82.0	80.7	79.4

In most parts of the Archipelago the discomfort one would expect from the continued high temperature and humidity is greatly mitigated by the very general presence of refreshing breezes, particularly at midday and in the afternoon and early evening. The velocity and frequency of the wind in the vicinity of Manila is greatest during the season when the temperature elevation is the greatest (March to September). The average daily velocity of the wind for Manila is 217.8 kilometers, the monthly averages varying from 149.3 in December to 291.0 in September.

ACTINIC POWER OF THE SUNLIGHT.

Of late years the chemical activity of the sunlight has become a factor which, in the opinion of many, should be considered in discussing climate and its influences. Freer,(1) Gibbs,(14) and Bacon,(15) at the Bureau of Science in Manila, have found that the tropical sunshine produces chemical changes which take place either more slowly or not at all in temperate climates. It has also been shown by Freer that there are in the Philippines "actinic" and "nonactinic days," the chemical action of the sunlight during the latter being much less powerful, even though the sky may seem as clear as on an actinic day. The causes of these differences have not been determined. The investigations at the Bureau of Science have shown that the spectrum of the sun's rays extends into the ultra-violet little if any farther in Manila than in temperate regions.(4)

That concentrated ultra-violet rays have a harmful influence on bacteria, as well as on some higher forms of life such as protozoa, has been clearly proven by many observations made by ourselves(18) and by others.(19) Some writers, notably Woodruff,(2)(3) have considered that such rays were very injurious to white men, more especially to

those of the blond type. The subject needs much more study before a definite conclusion can be reached regarding the influence of the chemical rays of the solar spectrum, but the recent work by Aron(4) seems to indicate that the deleterious influence of the tropical sunlight on men and animals is due to the long heat-rays rather than to the short length ultra-violet waves. Steinmetz(5) considers ultra-violet radiations of moderate intensity, such as occur in sunlight, to be harmless to the eyes. When acting on the skin ultra-violet rays have little power of penetration, being absorbed by the blood, but whether they can produce such changes in that fluid as to lead to constitutional disturbances still remains an unsettled problem.

PART II. PHYSICAL EXAMINATIONS AND LABORATORY TESTS ON BLONDS AND BRUNETTES OF THE 1909–GROUP AND THE 1910–GROUP.

The work on the 1909–Group began in the first quarter of 1909 and ended in December of that year, there being records for each man of 4 observations evenly spaced over an interval of about eleven months. The examinations of the 1910–Group began in the second quarter of the year 1910 and ended at the same time in 1911, there being for each soldier 5 complete observations spaced at approximately three-month-intervals during the period of one year. The observations were made under our supervision by the gentlemen named in footnotes 3 and 5. All of these officers are thoroughly familiar with the laboratory methods involved in the work, and the number of observers minimizes the influence of the personal equation.

It should be understood that the men under observation were healthy soldiers, any who showed evidence of disease having been excluded before the beginning of the observation period. The length of time the men had served continuously in the Philippines at the commencement of the test varied from two months to several years.[10] The average length of the present tour of tropical service at the *beginning* of the year of observation was in the 1909–Group for the blonds 14.9 months and for the brunettes the same. In the 1910–Group it was for the blonds 6.4 and for the brunettes 6.7 months. In both groups it will be seen that the average period of tropical service prior to the commencement of the observations was sufficient for the preliminary stimulating effect of the Tropics to have passed away. At the beginning of the observation period the total tropical service, including present and previous tours, in the 1910–Group was 32.9 months for the blonds and 34.4 months for the brunettes. In the 1909–Group the average height was the same for both blonds and brunettes, 67.4 inches (171.1 centimeters), and the average age was practically the same, 25.5 years for the blonds and 25.1 for the brunettes. In the 1910–Group the average height was 67.8 inches (172.2 centimeters) for the blonds and 67.3 inches (170.9 centimeters) for the brunettes, and the average age was 27.4 years for the blonds and 28.1 years for the brunettes.

[10] The men with several years' service had voluntarily transferred from organizations going home to others just arriving in the Islands. One man we have in mind was a most conspicious blond and had been twelve years continuously in the Philippines, remaining in perfect health.

These soldiers were dressed in a loose fitting uniform made of khaki-colored drilling and habitually wore white cotton undershirts and drawers. The headgear for nearly all consisted of a narrow-brimmed helmet covered with khaki cloth. In general the clothing was the same for the men of the Scout–Constabulary–Police–Group which is to be considered further on.

The observations on both the 1909–Group and the 1910–Group will be taken up together and discussed under various subheads.

Weight.—The maintenance of a weight proportionate to the height is generally considered one of the best guides to the health of the individual and, therefore, the average of the individual weight observations was deemed of much importance in deciding whether a difference was manifest between the blond and the brunette groups. The results are shown in the following tables.

TABLE V.—*Comparative average weights of 111 blonds and 118 brunettes, 1909–Group.*

Type.	Height.		Weight.									
			First quarter.		Second. quarter.		Third quarter.		Fourth quarter.		Loss for year.	
	Ins.	*Cm.*	*Lbs.*	*Kgms.*	*Lbs.*	*Kgms.*	*Lbs.*	*Kgms.*	*Lbs.*	*Kgms.*	*Lbs.*	*Kgms.*
Blond ----	67.4	171.1	142.8	64.9	141.4	64.3	140.7	64.0	140.2	63.7	2.6	1.18
Brunette -	67.4	171.1	144.5	65.6	142.7	64.9	142.7	64.9	141.8	64.5	2.7	1.23

TABLE VI.—*Comparative average weights of 307 blonds and 301 brunettes, 1910–Group.*

Type.	Height.		Weight.											
			Second quarter 1910.		Third quarter 1910.		Fourth quarter 1910.		First quarter 1911.		Second quarter 1911.		Loss for year.	
	Ins.	*Cm.*	*Lbs.*	*Kgms*	*Lbs.*	*Kgms*	*Lbs.*	*Kgms*	*Lbs.*	*Kgms*	*Lbs.*	*Kgms*	*Lbs.*	*Kgms.*
Blond ---	67.8	172.2	148.1	67.3	147.8	67.2	147.8	67.2	147.2	66.9	146.1	66.4	2.0	.91
Brunette	67.3	170.9	148.3	67.4	147.7	67.1	147.3	67.0	147.3	67.0	146.5	66.6	1.8	.82

On examining Tables V and VI it will be seen that both groups declined slightly and progressively in weight during the year of observation and that there was no significant difference in the degree of loss for the blond type and the brunette type. In the 1910–Group the blonds lost 0.2 of a pound (0.09 kilogram) more than the brunettes, but in the 1909–Group the conditions were reversed and the brunettes lost 0.1 of a pound (0.05 kilogram) more than the blonds. In either instance the differences in the respective losses of the two types are so trivial as to be of no importance.

Temperature.—The temperature observations were taken by mouth and in nearly all instances in the 1910–Group the thermometers were kept in for five minutes to insure registry of slight degrees of fever if present. The results appear in Tables VII and VIII.

TABLE VII.—*Comparative average temperatures of 111 blonds and 118 brunettes, 1909–Group.*

Type.	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Average for year.	
	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
Blond	98.8	37.1	98.8	37.1	99.1	37.3	98.7	37.0	98.9	37.2
Brunette	98.9	37.2	98.8	37.1	99.0	37.2	98.6	37.0	98.8	37.1

TABLE VIII.—*Comparative average temperatures of 307 blonds and 301 brunettes, 1910–Group.*

Type.	Second quarter 1910.		Third quarter 1910.		Fourth quarter 1910.		First quarter 1911.		Second quarter 1911.		Average for year.	
	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
Blond	98.8	37.1	98.8	37.1	98.7	37.0	98.6	37.0	98.7	37.0	98.7	37.0
Brunette	98.7	37.0	98.8	37.1	98.8	37.1	98.6	37.0	98.7	37.0	98.7	37.0

At one or more of the quarterly periods there were found among the men of both types some cases of elevation of temperature without assignable cause, but it will be obvious on examining the tables that these occurrences were not sufficiently numerous to raise the average temperature for the year materially above the recognized normal for temperate climates. The average temperature for the blonds at no quarterly period varied more than 0°.1 F. (0°.06 C.) from the corresponding figure for the brunettes, sometimes one type and sometimes the other showing the higher figure. For the whole year the average for the two types was the same for the 1910–Group and but 0°.1 F. (0°.06 C.) different in the 1909–Group. Therefore, it was concluded that as regards the maintenance of bodily temperature in the Tropics there were no constant differences between the blond and the brunette types.

Pulse and respiration.—The pulse and respiration were taken as a rule with the men seated. At the few posts where the record was made with the men standing the numbers of blonds and brunettes were approximately equal so the relative influence of this factor is the same for the two complexion types. The results are shown in Tables IX and X.

TABLE IX.—*Comparative average pulse and respiration rates of 111 blonds and 118 brunettes, 1909–Group.*

Type.	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Average for year.	
	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.
Blond	82.1	19.7	92.6	20.8	89.3	19.8	84.6	19.2	87.2	19.9
Brunette	83.1	20.6	91.5	20.7	93.5	20.7	85.6	19.2	89.2	20.3

TABLE X.—*Comparative average pulse and respiration rates of 307 blonds and 301 brunettes, 1910–Group.*

Type.	Second quarter 1910.		Third quarter 1910.		Fourth quarter 1910.		First quarter 1911.		Second quarter, 1911.		Average for year.	
	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.	Pulse.	Respiration.	Pulse	Respiration.
Blond	77.0	19.3	77.8	19.2	77.5	19.1	77.1	19.1	77.0	19.0	77.3	19.1
Brunette	77.6	19.4	76.7	19.4	77.6	19.2	77.3	19.5	77.2	19.4	77.3	19.4

It is shown by the tables that the average pulse rate for the year is the same for both complexion types in the 1910–Group. In the 1909–Group it is two beats nearer the normal Temperate Zone standard for the blonds than it is for the brunettes. The quarterly variations are inconsiderable and variable, first one complexion type and then the other being the higher. For both types the rate is considerably above the accepted normal average for cool countries, the higher rate for the 1909–Group being, in our opinion, due to the fact that most of these observations were made immediately after the men returned from drill or a practice march. The respiratory rates on the average are a few tenths of a respiration lower for the blonds than for the brunettes, but for both types and at all quarterly observations are considerably higher than the accepted normal of 14 to 18 per minute for healthy adults in Europe and America. As would be expected an increase in the frequency of the pulse and the respiration go hand in hand and the increase of both rates in the Tropics is in accord with the observations of Jousset, Plehn, and others, but differs from the experience of Rattray.(7) The conclusion was reached that the brunettes show no advantage over the blonds as regards either pulse or respiration rates.

Systolic blood-pressure.—Nearly all the observations were made with the soldiers in the sitting posture. At a few posts the readings were taken when the men were reclining, but as this was done with equal frequency among the blonds and among the brunettes it does not affect the comparison for the two types, even if it were generally accepted, (which is not the case) that there is a material difference in the pressure as a result of these changes in position.(6) The instrument used was Cook's modification of the Riva-Rocci apparatus, with an 8-centimeter cuff. By a careful comparison of the same instrument on several hundred men, using both an 8-centimeter and a 12.5-centimeter armlet, it was found that the average reading with the latter was 8 millimeters lower than with the former. Therefore, in the tables the averages have been reduced to the basis of a 12.5-centimeter cuff by deducting 8 millimeters from the actual findings.

TABLE XI.—*Comparative average systolic blood-pressure with 12.5-centimeter armlet for 111 blonds and 118 brunettes, 1909–Group.*

Type.	Average age.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average for year.
	Years.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Blond	25.5	115.8	112.5	114.2	116.8	114.8
Brunette	25.1	118.6	115.3	115.1	118.2	116.8

TABLE XII.—*Comparative average systolic blood-pressure with 12.5-centimeter armlet for 206 blonds and 198 brunettes, 1910–Group.*

Type.	Average age.	Second quarter 1910.	Third quarter 1910.	Fourth quarter 1910.	First quarter 1911.	Second quarter 1911.	Average for year.
	Years.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Blond	27.4	116.3	118.5	117.7	117.4	118.0	117.6
Brunette	28.1	117.9	117.2	117.8	117.7	117.3	117.6

Since the blood-pressure is in reality an index of the functional capacity of the heart, as correlated with the peripheral and visceral resistance and the volume of the circulating fluid, it would seem that its determination should be an excellent indication of the circulatory condition of a group of men. It will be observed that the pressures recorded in the tables are in close accord with the findings of other tropical observers.(8) We have found the blood-pressure for Filipinos to be approximately the same as the figures given in Tables XI and XII. This feature together with other points relating to the blood tension in the Tropics will be discussed at length in a subsequent communication devoted to blood-pressure alone.(20) It will be sufficient at this time to point out that the average pressures throughout the year for the blonds and the brunettes of the 1910–Group were identical while in the smaller 1909–Group the difference was only 2 millimeters of mercury. If the two groups are combined we obtain an average for 317 blonds of 116.7 millimeters and for 316 brunettes of 117.3 millimeters. This is a difference of only 0.6 millimeter, an amount which is entirely without significance. It should be noted that the average ages of the two groups were approximately the same, the maximum difference being only 0.7 year.

Dynamometer observations.—These strength tests were made with the usual hand dynamometer which registers simply the force of the maximum grip. The results appear in Tables XIII and XIV.

TABLE XIII.—*Comparative average dynamometer tests on 111 blonds and 118 brunettes, 1909–Group. Registered in kilograms.*

Type.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average for year.	Gain for year.	Average height.	Average weight.
							cm.	*Kilos.*
Blond	51.7	52.1	51.1	53.0	52.1	1.3	171.1	64.1
Brunette	52.8	52.5	51.3	53.3	52.5	0.5	171.1	65.0

TABLE XIV.—*Comparative average dynamometer tests on 31 blonds and 31 brunettes, 1910–Group. Registered in kilograms.*

Type.	Hand.	Second quarter 1910.	Third quarter 1910.	Fourth quarter 1910.	First quarter 1911.	Second quarter 1911.	Average for year	Gain for year.	Average height.	Average weight.
									cm.	*Kilos.*
Blond	Right	54.0	52.5	53.2	54.5	54.2	53.7	0.2	173.0	67.0
Brunette	Right	52.2	52.7	55.1	55.3	54.8	54.0	2.6	171.2	67.0
Blond	Left	49.2	48.0	48.9	50.3	50.0	49.3	0.8	173.0	67.0
Brunette	Left	47.6	48.2	50.2	50.3	50.8	49.4	3.2	171.2	67.0

The fact that the average strength of the grip increased during the year we believe to be due not to any definite increase in strength on the part of the groups, but rather to the acquisition, through practice and familiarity with the instrument, of an increased dexterity in compressing the dynamometer. In the large 1909–Group this gain was a little more marked for the blonds than for the brunettes. In the 1910–Group the gain in strength of grip in each hand was much more marked for the brunettes, but this group is so small (only 31 men of each type) that the element of chance assumes considerable importance. If all the right hand readings of the first and last observations for both the 1909–Group and the 1910–Group are averaged the gain in grip strength for the blonds is 1 kilogram and for the brunettes 0.9 kilogram, a trivial advantage in favor of the blonds. It will be noted that throughout both years the grip record of the blonds is generally a trifle less than that of the brunettes, but this is probably due to the slight advantage in physical development which the brunettes in the two groups seem to show, as evidenced by the relationship of their average weight and height as compared with the same data for the blonds.

On the whole it appears that the dynamometer tests failed to indicate that the brunettes possessed any appreciable advantage over the blonds as regards the maintenance of their strength.

Hæmoglobin estimations and counts of the red blood cells.—Most of the hæmoglobin estimations were made with the Dare hæmoglobinometer and the blood counts were performed with the Thoma-Zeiss hæmocytometer. The results are given in the following tables:

TABLE XV.—*Comparative average hæmoglobin and red blood cell estimations on 26 blonds and 39 brunettes, 1909–Group.*

Type.	January.			July.			December.		
	Hæmoglobin.	Red cells.	Color index.	Hæmoglobin.	Red cells.	Color index.	Hæmoglobin.	Red cells.	Color index.
	Per ct.			*Per ct.*			*Per ct.*		
Blond	88.4	5,307,000	0.83	87.5	5,411,000	0.80	88.9	5,096,000	0.88
Brunette	89.8	5,255,000	0.85	88.7	5,317,000	0.83	90.7	5,189,000	0.87

TABLE XVI.—*Comparative average hæmoglobin and red cell estimations on 288 blonds and 279 brunettes at beginning and at end of observation period, 1910–Group.*

Type.	Second quarter 1910.			Second quarter 1911.		
	Hæmoglobin.	Red cells.	Color index.	Hæmoglobin.	Red cells.	Color index.
	Per ct.			*Per ct.*		
Blond	90.0	5,158,000	0.87	89.3	5,185,000	0.87
Brunette	90.5	5,063,000	0.89	89.9	5,229,000	0.86

In both groups we have obtained results similar to those previously reported by Wickline[9] and by Phalen of this Board[10]; namely, a red corpuscle count ranging above 5,000,000 and a hæmoglobin average approximating 90 per cent. Therefore the color index is low, our figures for different periods ranging from 0.80 to 0.89. Since the observations of about a dozen careful workers, comprising over 1,700 red cell counts and an equal number of hæmoglobin estimations, have all shown the same tendency, it appears to us certain that a high red corpuscle count and a rather low color index must be characteristic for the American who has lived one or two years in the Philippines.

When the two complexion types are compared it will be noted that in both the 1909–Group and the 1910–Group the differences, for corpuscular counts, for hæmoglobin and for color index, were slight and also were inconstant, at some observation periods the blonds and at others the brunettes being in the lead. If we combine and average the color indices for all the observations in each of the two groups it will be seen that the differences are only 0.014 for the 1909–Group and 0.005 for the much larger 1910–Group. Such slight variation are entirely without significance.

Leucocyte estimations, differential counts, and Arneth counts.—The white cell estimations were made with the Thoma-Zeiss blood counting instrument, and the differential and Arneth counts after staining films with Wright's stain. The examinations were made only at the end of the observation period of one year, a time when the men had served on the average for about twenty months continuously in the Tropics and in no individual case for less than fourteen months.

TABLE XVII.—*Comparative average leucocyte estimations and differential and Arneth counts for blonds and brunettes.*[a]

Type.	White count, per cu. mm.	Differential leucocyte count.					Arneth count.					Arneth index.
		Poly-nuc.	Small lymph	Large lymph	Eosin.	Baso-phile.	Class I.	Class II.	Class III.	Class IV.	Class V.	
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*						
Blond	6,980	54.8	34.3	6.2	3.9	0.9	11.5	31.6	38.2	16.2	2.1	43.1
Brunette	7,155	59.6	29.9	6.0	3.8	0.8	14.5	34.5	35.7	13.6	1.8	49.0

[a] These observations were made mostly on the 1910–Group, but some were on the members of the 1909–Group. The leucocyte counts are the average for 89 blonds and 86 brunettes; the differential counts are the average for 45 blonds and 45 brunettes; the Arneth counts are the average for 28 blonds and 28 brunettes, these being a part of the 45 men on whom the differential counts were made.

That the polymorphonuclear neutrophile count is very low (ranging from 50 to 60 per cent) for Filipinos and for white men with a year or more of Philippine service has been shown by Wickline,(9) Guerrero and Sevilla,(11) and by several members of this Board.(10)(12) Recently Chamberlain and Vedder(13) have confirmed the earlier observations and have shown that there is a marked shift to the left in the Arneth count for healthy Filipino laborers and a slight tendency in the same direction for white men residing in the Archipelago. It appears possible that the low count for the polymorphonuclear cells (phagocytes), together with the shift to the left in the Arneth picture (in other words a higher Arneth index), may indicate diminished phagocytic power for the blood in question and a lowered resistance to such infections as are combated in whole or in part by phagocytosis. Applying this theory to the blonds and brunettes it will seem that the evidence from the two methods of counting is conflicting. The percentage of polymorphonuclear neutrophiles is lower for the blonds than for the brunettes,[11] but on the other hand the shift to the left in the Arneth picture is more marked for the brunettes than for the blonds. The difference between the average white cell counts per cubic millimeter for the two types is so slight as to be unimportant.

[11] Wickline, examining soldiers with eighteen months of Philippine service, found the polymorphonuclear cells to constitute 54.3 per cent of the total leucocytes for blonds and 53.1 per cent for brunettes.(9)

From the foregoing it is concluded that the differential and the Arneth counts of this small series of men throw no light on the question of the relative resistance of the two complexion types.

Urinary examinations.—An examination of the urine was made on all of the men of the 1910–Group, once near the beginning and once near the end of the observation period, with a view to detecting any cases of nephritis. At the final examination albumin was found in 3 and casts in 3 of the brunettes while none of the blonds showed albuminuria and only 2 had casts. We attach no significance to these differences because of the small number of cases. An examination of the specific gravity averages are of some interest. The specific gravity of a single specimen of urine is of course in itself of little value, but when the specific gravity readings of single specimens from several hundred men are averaged the results have considerable importance in the direction of showing the condition of the group as regards renal elimination. It has been urged by some that in the Tropics there is a tendency to renal insufficiency, while others have considered that, as a result of excessive loss of fluid in the form of perspiration, the urine becomes too concentrated and is therefore irritating. The following table shows that the average specific gravity readings for the blonds and for the brunettes showed no differences worthy of consideration, and also that for both types the figures were those that are considered normal in the temperate zone. This latter opinion is based on 1,152 readings on 576 individuals which gives an average specific gravity of 1,019.8. The average 24-hour amount of urine is not known.

TABLE XVIII.—*Comparative average specific gravity readings for urine of 294 blonds and 282 brunettes, comprising 1,152 separate examinations, 1910–Group.*

Type.	Second quarter.	
	1910	1911
Blond	1,019.6	1,019.5
Brunette	1,020.2	1,019.8

Stool examinations.—At the completion of the year of observation, examinations were made of the stools of 308 blonds and 293 brunettes of the 1910–Group in order to determine if the two types showed any differences in the degree of infestation with intestinal parasites, especially uncinaria. No special search was made for amœbæ and no cathartic was given before obtaining the specimens. Three cover glass preparations were examined for each individual. The results are shown below.

TABLE XIX.—*Comparative numbers of men infested with intestinal parasites among 308 blonds and 293 brunettes, 1910–Group.*

Type.	Uncinaria.	Ascaris.	Trichocephalus.	Strongyloides.	Tænia.	Strongylus subtilis.	Balantidium.	Amœba coli.	Amœba dysenteriæ.	Hymenolypis.	Cercomonas.
Blond	7	13	8	2	0	1	1	1	0	0	9
Brunette	7	8	9	2	1	1	0	6	5	2	4

This table does not indicate as high a rate of infestation for blonds as for brunettes except with ascaris and cercomonas, which have little if any significance. The rate of hookworm infestation was slightly greater for the brunettes. This work confirms the previous observations of the writer(16) as to the infrequent occurrence of uncinariasis among American soldiers serving in the Philippines.

Special observations after exercise.—These examinations were made on the 1910–Group, once near the beginning and once near the end of the year of observation, with a view to determining whether the blonds became more easily exhausted by physical exertion than did the brunettes. The exercise preceding the examination was usually a practice march or a period of drilling, and was as nearly as possible the same for the two complexion types. The results are tabulated in the following table. For each kind of observation the time was the second quarter of the year, the first being in 1910 and the second in 1911.

TABLE XX.—*Comparative average observations after exercise on 241 blonds and 232 brunettes, 1910–Group. Blood-pressures with 12.5-centimeter armlet.*[a]

Type.	Weight.		Pulse.		Respiration.		Temperature.		Blood-pressure.	
	1910	1911	1910	1911	1910	1911	1910	1911	1910	1911
	Kgms.	*Kgms.*					°C.	°C.	*mm.*	*mm.*
Blond	66.6	66.4	85.9	82.7	21.2	20.8	37.2	37.0	125.4	123.8
Brunette	65.9	65.9	87.4	83.8	21.8	21.0	37.2	37.1	128.2	125.7

[a] The weights are the average for 169 blonds and 158 brunettes and the blood-pressures for 136 blonds and 124 brunettes.

On comparing this table with the preceding ones, which show the same class of observations when the men had not exercised, it is seen that as a result of the exertion there was a small average loss in weight, approximately 1 pound (0.5 kilogram), and a slight average increase in respiration rate and temperature, the increase of the former approximating two inspirations per minute and the latter 0°.1 C. The pulse rate was accelerated considerably, ranging from 5 to 10 beats per minute in excess of the rate when the men were at rest, and the systolic blood-pressure

was elevated more than 8 millimeters of mercury above the resting average. These are the effects which one would expect from moderate exercise indulged in by healthy, well trained men in hot weather. When we come to compare the two complexion types, it is interesting to note that the effects of the exertion were slightly more marked on the brunettes than on the blonds in all but one of the 20 observation averages, and in that one they were equal. The figures for examinations after exercise, as contrasted with those when the men were at rest, show that the loss of weight was a little more pronounced, and the elevation of the pulse, temperature, respiration, and blood-pressure was slightly more marked for the brunettes than it was for the blonds. We would not for a moment argue, because of these slight differences, that the brunettes are less fit than the blonds, but the figures certainly strongly indicate that the brunettes are *no better* able to endure exercise in the Philippines than are their fair skinned comrades.

SUMMARY OF PART II.

The differences between these exact observations on the blonds and on the brunettes are so slight and inconstant as to be of no significance. The tests fail to show any anatomical or physiological distinctions for the two complexion types in large groups of men who, at the end of the year of observation, had been continuously exposed to the Philippine climate for an average of 26.9 months in the case of the 1909–Group and 18.4 months in the case of the 1910–Group. This conclusion agrees with that reached by Wickline when examining American soldiers in the Philippines.(9)

PART III. RELATIVE AMOUNTS OF SICKNESS AMONG BLONDS AND BRUNETTES OF THE 1909–GROUP, THE 1910–GROUP, AND THE SCOUT–CONSTABULARY–POLICE–GROUP.

The relative number of admissions and of days on sick report for the blond and the brunette types in the 1909–Group and the 1910–Group is deemed to be of much value in this study, first, because of the large number of men considered (504 blonds and 500 brunettes) and, secondly, because of the long average period of tropical service over which the collection of the sick data extends. The statistics of sickness for the men have been obtained from their official sick record not only for the period of one year, during which the observations described in Part II were under way, but also for all the available continuous Philippine service of each man before the physical tests began and after they were concluded. As a result the sick records in the 1909–Group extend over an average period of considerably more than twenty-four months of unbroken tropical service. In the 1910–Group the average continuous Philippine residence during which the sick rates have been gathered is 22.4 months. For the combined groups the average approximates two years. The results are shown in Table XXI.

TABLE XXI.—*Comparative numbers of admissions to sick report and days lost from sickness for 504 blonds and 500 brunettes of the 1909–Group and the 1910–Group.*

Diagnoses.	Blonds.		Brunettes.	
	Admissions.	Days sick.	Admissions.	Days sick.
Diarrhœa and dysentery	74	822	68	569
Dyspepsia, indigestion, and gastritis	34	139	27	119
Constipation	18	63	28	82
Intestinal parasites	16	117	10	127
Coryza and bronchitis	25	178	12	56
Tonsillitis, pharyngitis, and catarrh	18	189	12	186
Malarial and undetermined fevers	95	638	93	586
Dengue fever	50	325	45	320
Neuralgia, myalgia and herpes zoster	9	66	12	150
Rheumatism; articular, acute, and chronic	5	58	11	291
Tuberculosis	5	69	3	75
Ringworm	18	178	17	136
Pemphigus, eczema, dermatitis, and ulcers	25	174	13	102
Furunculosis, carbuncle, cellulitis, and abscess	57	480	54	353
Lymphadenitis, nonvenereal	15	271	12	249
Appendicitis	4	83	4	54
Heat exhaustion	8	43	4	15
Diseases of eye and ear	16	368	14	276
Neurasthenia	2	52	1	19
Minor surgical conditions	41	616	41	519
Miscellaneous diseases	42	459	27	342
Accidental	129	1,375	121	1,202
Alcoholism and sequelæ	18	62	6	31
Venereal diseases	227	5,327	214	5,297
Total	951	12,152	849	11,156

Since the total numbers of men in each of the two complexion types are so nearly equal (504 and 500 respectively), we have not reduced the actual admissions and the actual days on sick report for each type to rates per 1,000, because such a reduction would not appreciably effect the comparison. It will be observed that the total number of admissions is 102 and the total number of days lost from sickness 996 greater for the blonds than for the brunettes. This means about 10 per cent more illness for the blond group. An advantage in favor of the brunettes is manifest for all of the more important causes of admission. While it must be admitted that there was considerably more sickness among the blonds under observation than among the brunettes, yet when it comes to a question of the occurrence throughout the whole Archipelago of the serious diseases which lead to invaliding home it will be seen that the brunettes were at a disadvantage as is to be shown further on in Table XXV.

The Scout–Constabulary–Police–Group.—For the sake of brevity this group will hereafter be referred to as the S–C–P–Group. It consisted of 568 men, of whom 186 were blonds, 147 brunettes, and 235 mixed types.

The reports from these persons cover an average of 5.5 years of continuous tropical service, the duration of Philippine residence for the individuals ranging from two to thirteen years. In reply to our questions as to illness a considerable proportion merely stated the number of times they have been sick and the cause of the disability, without giving the duration of the disease. Therefore Table XXII, which contains the data collected, simply shows the number of attacks of each illness, but does not give the days lost from sickness.

TABLE XXII.—*Comparative numbers of attacks of illness for the blonds, brunettes, and mixed types of the S–C–P–Group, while in the Philippines.*

Diagnoses.	Attacks of illness.					
	186 blonds.		147 brunettes.		235 mixed types.	
	Number.	Rate per 1,000.	Number.	Rate per 1,000.	Number.	Rate per 1,000.
Dysentery and diarrhœa	26	140	22	150	46	196
Malaria	58	312	60	408	68	289
Dengue	25	134	17	116	22	94
Fever, undetermined type	8	43	8	55	12	51
Appendicitis	8	43	10	68	10	43
Cholera	3	16	1	7	5	21
Pneumonia	6	32	0	0	1	4
Rheumatism	2	11	7	48	7	30
Indigestion	5	27	3	20	9	38
Typhoid fever	3	16	5	34	6	26
Neurasthenia	1	5	0	0	1	4
Skin diseases	3	16	0	0	4	17
Furunculosis	1	5	2	14	4	17
Ptomaine poisoning	3	16	3	20	4	17
Eye diseases	0	0	0	0	2	9
Accidental	3	16	7	48	4	17
Miscellaneous	13	70	18	122	48	204
Total attacks of illness	168	902	163	1,110	253	1,077
Never sick	85	456	53	361	90	383

For convenience in comparing, the admissions to sick report have been reduced to rates per 1,000 men of each type. First of all it is to be noted that the proportion of those *who had never been sick* is much higher for the blonds than it is for the brunettes. The total number of admissions for all diseases was considerably higher for the brunettes than for the blonds, 1,110 as compared with 902 *per mille*. Taking up the individual diseases it will be seen that the brunettes had a higher admission rate than the blonds for all diseases except dengue, cholera, pneumonia, indigestion, skin diseases, and neurasthenia. In the last disease the comparison is of no value since even among the blonds there was only one admission. For many of the diseases the mixed types showed a higher admission rate than did the blonds.

SUMMARY OF PART III.

The evidence adduced in this section is conflicting. While sickness was considerably more common among the blonds in the soldier group the reverse is true in the S–C–P–Group. Furthermore, in the latter group the proportion who had never been sick was materially larger among the blonds than among the brunettes. While the statistics were more complete and the number of men considered was much larger for the soldier group, it should be remembered that the period of time spent in the Philippines, and covered by the sick record, was much longer for the S–C–P–Group. Therefore, no conclusion pointing clearly in one direction or the other can be drawn from the statistics compiled in Part III. Of the 21 medical officers who observed the men of the 1910–Group, only one could note any difference in the two types and this officer, Lieutenant Mueller, was of the opinion that the blonds had "suffered from tropical influences somewhat more than the brunettes." He suggested that psychological tests might show deterioration that was not indicated by physical examinations. Unfortunately it was impracticable to make such observations.

PART IV. SYMPTOMATOLOGY AND DIETARY HABITS FOR THE 1910–GROUP AND FOR THE SCOUT–CONSTABULARY–POLICE–GROUP.

The information dealt with in this part was obtained in the case of the 1910–Group by questions addressed by the medical officers conducting the observations. To each member of the S–C–P–Group a blank form was sent with a request that the printed questions thereon be answered.[12] In setting a value on the following data, it must be remembered that we are dealing mainly with sensations and not with physical signs, and that in case of both officers and men it was well understood why the questions were being asked. The topic of the relative endurance of blonds and brunettes has received not a little popular discussion in the Archipelago, and, therefore, one must consider the possibility that some answers were unconsciously influenced by what the speaker or writer thought should take place.

The individual members of the S–C–P–Group had had continuous tropical service for periods ranging from two to thirteen years, the average being about 5.5 years. For the blonds it was 5.1 years, for the brunettes 5.5 years and for the mixed types 5.6 years. The average Philippine service for the 1910-Group was 18.5 months at the time the questions were asked. The numbers of answers to each question for each complexion type have been reduced to rates per 1,000 of that type in order to facilitate comparison. The replies are shown in Table XXIII, and will be discussed under several subheads.

[12] The data from the Constabulary and the Police were obtained through the courtesy of the Director of the Philippines Constabulary and the chief of the Manila police.

TABLE XXIII.—*Comparative symptomatology in Tropics of blonds and brunettes of Scout–Constabulary–Police–Group and 1910–Soldier–Group.*

Answer number.	Question.	Answer.	Scout–Constabulary–Police–Group.						1910–Soldier–Group.			
			186 blonds.		147 brunettes.		235 mixed types.		323 blonds.		315 brunettes.	
			Number.	Rate per 1,000.	Number.	Rate per 1,000.	Number.	Rate per 1,000.	Number.	Rate per 1,000.	Number.	Rate per 1,000.
1	Have you ever had sunstroke or heat exhaustion?	Yes	7	38	4	27	14	60	16	50	14	44
2	Do you enjoy tropical service?	No	12	65	8	54	27	115	123	381	118	375
3		Yes	174	935	139	946	208	885	200	619	197	625
4	Do you feel as well in the Tropics as at home?	No	27	145	16	109	41	174	79	245	76	241
5		Same	145	780	115	782	168	715	230	712	228	724
6		Better	12	65	16	109	26	111	14	43	11	35
	In Tropics do you suffer from—											
7	Insomnia?	Yes	13	70	5	34	20	85	14	43	21	66
8	Anorexia?	Yes	14	75	9	61	17	72	18	56	20	63
9	Indigestion?	Yes	31	167	26	177	45	191	23	71	24	76
10	Diarrhœa?	Yes	8	43	9	61	16	68	----	----	----	----
11	Palpitation of the heart?	Yes	9	48	12	82	12	50	12	37	14	44
12	Sore eyes?	Yes	14	75	8	54	19	81	15	46	11	35
13	Loss of memory?	Yes	51	274	33	224	65	277	29	90	34	108
14	Do you lose weight in Tropics?	Yes	41	220	32	218	49	209	----	----	----	----
15	Do you gain weight in Tropics?	Yes	64	344	52	354	89	379	----	----	----	----
16	Does direct sunlight affect you unpleasantly?	Yes	54	290	41	279	73	311	72	223	70	222
	In the sunlight do you suffer from—											
17	Vertigo?	Yes	9	48	18	122	20	85	39	121	30	95
18	Headache?	Yes	35	188	22	150	41	174	48	149	44	140
19	Nausea?	Yes	4	22	3	20	2	9	11	34	5	16
20	Vomiting?	Yes	----	----	----	----	----	----	4	12	3	10
21	Photophobia?	Yes	55	296	45	306	87	370	70	217	64	203
22	Excessive thirst?	Yes	20	108	13	88	30	128	43	133	36	114
23	Excessive redness of face?	Yes	----	----	----	----	----	----	40	124	26	83
24	Shortness of breath?	Yes	18	97	11	75	13	55	----	----	----	----
25	Do you suffer from lassitude on arising?	Yes	23	124	17	116	47	200	47	146	47	149
26	Are you irritable in the Tropics?	Yes	51	274	45	306	92	391	44	136	52	165
27	Are you depressed in the Tropics?	Yes	21	113	22	150	29	123	41	127	40	127
28	Do you take a siesta regularly?	Yes	39	210	38	259	66	281	146	452	174	552
29	How do your dietary habits compare with those at home?	Same	145	780	121	823	186	792	276	854	273	866
30		Eats less	15	81	13	88	33	140	33	102	25	79
31		Eats more	6	32	5	34	4	18	10	31	12	40
32		Unknown	20	108	8	54	12	50	4	12	5	16

Sunstroke and heat exhaustion.—This question covered the whole period of the man's life, and many of the cases occurred in America. In the S–C–P–Group the rate for sunstroke and heat exhaustion was higher for the blonds (38 *per mille*) as compared with the brunettes

(27 *per mille*), but was a great deal higher still for the mixed types (60 *per mille*). In the 1910–Group the rate was also higher for the blonds, but the difference was less marked than in the S–C–P–Group, 50 as compared with 44 *per mille*. In considering the figures for the S–C–P–Group it must be borne in mind that the total number of cases was very small, only 7 for the blonds and 4 for the brunettes, so the element of chance may assume very large proportions.

Enjoyment of tropical service.—In the 1910–Group there was no material difference, the rates of those who did not enjoy such service being 381 for the blonds and 375 for the brunettes. In the S–C–P–Group the difference was more marked, 65 *per mille* of the blonds not enjoying the Tropics as compared with 54 *per mille* of the brunettes. However the number of men from the mixed type who did not like such service was far higher than among the blonds, 115 per 1,000. That a much greater proportion of the 1910–Group, as compared with the S–C–P–Group, should dislike the service is natural when it is recalled that the former were enlisted men serving in the Philippines largely from necessity, while the latter were officers and policemen who had elected to reside in the Archipelago, in most cases after having had some preliminary experience with its climate.

Feeling of well-being in the Tropics.—The proportion of soldiers in the 1910–Group who did not feel as well in the Philippines as at home showed no material variation for the blonds and for the brunettes, 245 *per mille* for the fair and 241 for the dark complexioned. In the S–C–P–Group the difference was much more marked, 145 per 1,000 of the blonds not feeling as well as in America and only 109 per 1,000 of the brunettes. But here again the mixed types suffered more severely than the blonds, 174 *per mille* of them failing to feel as well as in the homeland. In the 1910–Group the number of blonds who felt better than in America was larger than the corresponding number of brunettes (43 as compared with 35 *per mille*), but in the S–C–P–Group the conditions were reversed, 109 per 1,000 of the brunettes feeling better as compared with only 65 per 1,000 of the blonds. However, the actual numbers of men in this class were small in both groups. The numbers who felt the same here as at home were practically equal for the blonds and for the brunettes in the S–C–P–Group and in the 1910–Group.

With reference to the special symptoms complained of, the actual figures can best be seen in Table XXIII, and it will be sufficient to state here that in the S–C–P–Group the incidence of insomnia, anorexia, sore eyes, and loss of memory was considerably more marked for the blonds while in the 1910–Group the reverse was the case for all except eye troubles. In both groups indigestion, palpitation of the heart, and diarrhœa were more common among the brunettes. It is interesting to

note that for each of the above 7 symptoms, except anexoria, the incidence *per mile* in the S–C–P–Group was higher for the mixed types than for the blonds.

Influence of direct sunlight.—In both groups the number *per mille* of blonds who stated that direct sunlight affected them unpleasantly was slightly greater than that of the brunettes, but the differences were immaterial. Again it happened that the mixed types who made complaint were in excess of the blonds. The special symptoms asked about: namely, vertigo, headache, nausea, vomiting, photophobia, excessive thirst, and excessive redness of the face, were all somewhat more common among the blonds than among the brunettes of the 1910–Group, while in the S–C–P–Group the results were similar except for photophobia and vertigo, the former being slightly and the latter two and one-half times more common among the brunettes. Several of these symptoms were of more frequent occurrence among the mixed types than among the blonds.

General symptoms.—Lassitude on arising in the morning was slightly more common among the brunettes of the 1910–Group and among the blonds of the S–C–P–Group, but in this latter group the mixed types were much more affected than the blonds. Both irritability and depression were equally common or more common among the brunettes than among the blonds in each group. Both of these sensations were far more frequent among the mixed types than among the blonds of the S–C–P–Group.

Dietary and siesta habits, and maintenance of weight.—The numbers per thousand who ate the same amount and kind of food as at home was slightly less for the blonds than for the brunettes in both groups. In the 1910–Group increased consumption of food in the Tropics was more common among the brunettes, while in the S–C–P–Group there was no appreciable difference. The numbers of men *per mille* in the S–C–P–Group who lost weight were equal for the two complexion types, and there was no material difference in the numbers of those who gained weight. In other words complexion did not influence the weight in the S–C–P–Group, and it has been shown in Tables V and VI that the same was true for the 1909–Group and the 1910–Group. In both groups the siesta habit was very much more frequent among the brunettes. For the mixed types it was even more common than for the brunettes.

SUMMARY OF PART IV.

Summing up the subjective evidence contained in Table XXIII it may be said that for the 1910–Group, with its 18.5 months of tropical service, the differences are so slight and so variable for the two types that no clear distinction can be made out in the climatic effects produced on the blonds and on the brunettes. In the case of the S–C–P–Group.

with its 5.5 years of Philippine service, the results are inconclusive. On most of the points the advantage seems to be with the brunettes, but on a few the reverse is the case. It is interesting to note that the men of mixed type, who stand intermediate between blonds and brunettes, appeared to suffer from the deleterious influence of the tropical climate more markedly, for nearly every point investigated, than did the individuals of the blond type. This latter fact suggests that some factor other than complexion (possibly chance), may have had a hand in moulding the results in the S–C–P–Group.

PART V. RELATIVE PROPORTIONS OF BLONDS AND BRUNETTES AMONG SOLDIERS INVALIDED HOME, AND IN THE SCOUT–CONSTABULARY–POLICE–GROUP, AS COMPARED WITH THE PROPORTIONS OF THE SAME TYPES AMONG 10,072 SOLDIERS.

As a standard for comparison we carefully examined 10,072 enlisted men of the United States Army in the Philippines during the years 1909, 1910, 1911, and divided them into 3 complexion types, blond, brunette, and mixed, using the classification referred to just below Class VI under "Sources of Evidence." The results are shown in Table XXIV.

TABLE XXIV.—*Comparative number of blonds, brunettes, and mixed types among 10,072 soldiers (1909 to 1911).*

	Blond.	Brunette.	Mixed type.
Actual number	2,403	2,073	5,596
Rate per 1,000 men	238	206	556
Rate per 100 blonds	100	86	233

In the last line of Table XXIV the actual numbers have been reduced to a percentage basis for subsequent comparison with other groups of men and it is seen that for each 100 blonds there were 86 brunettes and 233 of the mixed type.

SOLDIERS INVALIDED HOME.

The figures in Table XXIV may be taken as representing the average proportions of the 3 types among the enlisted personnel of the Army serving in the Philippines at the time of these observations. If the climate be more harmful to the blonds than to the brunettes we should expect that the proportions of incapacitated blonds to incapacitated brunettes would be greater than the ratio of 100 to 86. To determine if such were the case, we have carefully inspected during the last eighteen months all soldiers invalided home from the Philippines and the results, giving actual numbers and rates per 1,000 men, are shown in Table XXV. The mean strength of the command from which this invaliding occurred was approximately 11,678 men.

TABLE XXV.—*Diagnoses of men invalided home, arranged by complexion types.*

Diagnoses.	Blonds.		Brunettes.		Mixed types.		Total, all types.	
	Number.	Rate per 1,000 men.	Number.	Rate per 1,000 men.	Number.	Rate per 1,000 men.	Number.	Number.
Nervous diseases:								
Neurasthenia	5		10		2		17	
Epilepsy	2		4		1		7	
Miscellaneous	7		4		3		14	
Total nervous	14	368	18	474	6	158		38
Mental diseases:								
Dementia præcox	4		9		6		19	
Melancholia	1		2		1		4	
Depressional insanity			1		1		2	
Insanity, type undetermined	4				5		9	
Defective mentality			5		1		6	
Total mental	9	225	17	425	14	350		40
Intestinal diseases:								
Sprue	1		1		1		3	
Enteritis, chronic	4		8		5		17	
Dysentery, chronic			1		1		2	
Diarrhœa, chronic	1		1				2	
Ulcer of rectum			1				1	
Total intestinal	6	240	12	480	7	280		25
Venereal diseases; all forms	4	364	5	454	2	182	11	11
Blood and circulatory diseases:								
Valvular lesions	1		2		3		6	
Anæmia, pernicious	1				1		2	
Anæmia, secondary	1				2		3	
Polycythemia	1						1	
Phlebitis	2						2	
Total blood and circulatory	6	429	2	142	6	429		14
Tuberculosis; all forms	22	314	27	386	21	300	70	70
Malaria and its sequelæ	2	500	1	225	1	225	4	4
Alcoholism, chronic	3	600	1	200	1	200	5	5
Gout and chronic rheumatism			3	500	3	500	6	6
Kidney diseases; all forms	2	333	4	667			6	6
Pulmonary diseases (except tuberculosis)	2	286	3	428	2	286	7	7
Diseases special senses:								
Deafness	1				1		2	
Otitis media and externa	3		1		3		7	
Retinitis	2				1		3	
Total special senses	6	500	1	83	5	417		12
Sunstroke		0		0	1	1,000	1	1
Wounds and injuries	4	191	7	333	10	476	21	21
Miscellaneous diseases	4	308	5	384	4	308	13	13
Totals	84	308	106	388	88	304	273	273
Rate per 100 blonds	100		126		99			

On examining the total numbers of each type invalided home from all causes (which have been reduced to a percentage basis in the last line of Table XXV) one immediately notices that the proportion of mixed types is considerably lower than was the case among the 10,072 men taken as a standard. Turning to the blonds and brunettes it is seen that the ratio is 100 to 126, whereas the ratio of blonds to brunettes among 10,072 soldiers was 100 to 86. In other words while the blonds exceed the brunettes in the general military population the reverse is the case in the total of invalided men. This is strong evidence that the blonds do not suffer unduly from the influence of the climate, but is at variance with the evidence adduced in Part III showing that there is more sickness among the blonds than among the brunettes.

On considering the special causes of incapacity it is seen that tuberculosis heads the list in importance, and shows a larger rate for brunettes than for blonds. In both nervous and mental diseases the rate is much higher for the brunettes. Neurasthenia, which especially has been attributed by some to the influence of the tropical sunlight, was nearly twice as frequent a cause of incapacity for the brunettes as for the blonds, and the same was true for intestinal and kidney diseases. Venereal diseases, gout and rheumatism, pulmonary troubles, accidents, and miscellaneous affections were all higher for the brunettes. Only in circulatory and blood diseases, alcoholism, malaria, and disturbances of the special senses were the blonds the greater sufferers.

We would not argue from such a comparatively small series that the blonds are better able to withstand a tropical climate than are the brunettes, but we do consider that Tables XXIV and XXV indicate that they are *fully as resistant* to the Philippine climate as are their darker skinned companions.

RATIO BETWEEN THE THREE TYPES IN SCOUT–CONSTABULARY–POLICE–GROUP.

The members of this group have voluntarily elected to reside in the Philippines, usually after having had some preliminary experience with the climatic conditions. Many of them have been in the Archipelago for twelve or thirteen years and the average length of continuous tropical service is 5.5 years. Nearly all of the Scout officers and the policemen originally came to the Archipelago as enlisted men in the Army, and a good proportion of the Constabulary officers also were drawn from that class. If the climate of the Philippines affected blonds more seriously than brunettes we should expect that after several years' residence the ranks of the blonds would be depleted by death, invaliding, and voluntary departure, and that the ratio of blonds to brunettes would be lower than the same ratio among the enlisted men (Table XXIV) from whom the S–C–P–Group sprang. Such is not found to be the case. Among the 568 men of the S–C–P–Group there were 186 blonds, 147 brunettes, and

235 mixed types. Reducing these to the percentage basis we have, for each 100 blonds, 79 brunettes and 126 of the mixed type. It will be observed that the proportion of the latter type is lower than the Army average (Table XXIV), but that the proportion of blonds as compared with brunettes is higher than the average for enlisted men of the Army in the period from 1909 to 1911 (100 to 79 as contrasted with 100 to 86).

These facts tend to show that in an average tropical service of 5.5 years the relative resistance of the blonds is not so impaired as to lead to a depletion of their ranks disproportionate to that occurring among the brunettes. To refute these deductions it might be argued that the proportions of the three complexion types among the American troops may not have been the same 6, 8, 10 or 12 years ago, at which times many members of the S–C–P–Group severed their connections with the regular Army, and that originally the blonds may have been much in excess of the brunettes in the S–C–P–Group. We have no statistics as to the proportions of the different complexion types in the Army for the period 1898 to 1901 and it is possible that in the earlier part of this period blonds may have been relatively somewhat more numerous, especially among the Western volunteers. However, we do have some statistics gathered in 1902 and 1903 by Woodruff,(2) and tabulated on page 215 of his book on Tropical Light.[13] Out of 1,294 soldiers there were 420 blonds, 356 brunettes, and 518 mixed types. Reduced to the percentage basis he found for each 100 blonds, 85 brunettes and 123 of the mixed type. On comparing these figures with those in the last line of Table XXIV it is seen that the blonds were not appreciably more numerous in the Army in 1902–3 than they were in 1909–11, and that they were considerably less numerous than they are at the present time (1911) in the S–C–P–Group.

SUMMARY OF PART V.

The ratio of invaliding home is lower for the blonds than for the brunettes. The ranks of the blonds in the S–C–P–Group after 5.5 years' tropical service, have not been depleted, the proportion of the fair complexion type being probably higher in the S–C–P–Group now than it was among the class from which that group was originally drawn. These are strong arguments in favor of the assumption that the blonds are quite as well able as the brunettes to resist the tropical conditions met with in the Philippines at the present time.

[13] Our system of classifying men into blonds and brunettes is the same as that described by Woodruff. His ratio of blonds to brunettes agrees closely with ours, but we find a considerably larger mixed class than he reports.

PART VI. CHARACTER, COURT-MARTIAL RECORDS AND SICK RATES FOR ALCOHOLISM AND VENEREAL DISEASE IN THE 1910–GROUP.

Woodruff(3) quotes some figures in support of a theory that the irritation produced by an excessive amount of sunlight may effect the conduct unfavorably and increase the prevalence of crime. If such is the case it is conceivable that misdemeanors would be more frequent among blonds than among brunettes in the Tropics. With a view to investigating this point the following tables have been compiled for the 1910–Group. The first shows the number of trials by courts-martial, the fines and days of confinement resulting therefrom, the military character given the men by the company commanders, and any changes of character occurring while in the Philippines. The other gives the degree of alcoholic consumption and the days on sick report from alcoholism and venereal diseases.

TABLE XXVI.—*Comparative character and comparative averages of court-martial trials, confinement and fines for 345 blonds and 343 brunettes, 1910–Group.*

Type.	Military character.						Change of character.			Disciplinary measures.		
	Excellent.	Very good.	Good.	Fair.	Bad.	No statement.	Better.	Worse.	No change.	Trials number.	Confinement, days.	Fines, dollars.
Blond	207	72	29	9	1	27	4	12	329	0.4	3.9	3.49
Brunette	202	73	26	8	0	34	7	8	328	0.4	3.6	3.97

TABLE XXVII.—*Comparative consumption of alcohol and comparative numbers of days lost from alcoholism and venereal disease for approximately equal numbers of blonds and brunettes.*[a]

Type.	Consumption of alcohol.				Days on sick report from—	
	None.	Slight.	Moderate.	Excessive.	Alcoholism.	Venereal disease.
Blond	62	110	138	13	62	5,327
Brunette	61	82	163	9	31	5,297

[a] The figures for consumption of alcohol are for 323 blonds and 315 brunettes of the 1910–Group. The days lost on sick report from alcoholism and venereal disease are for 504 blonds and 500 brunettes, all the men in both the 1909–Group and the 1910–Group.

In both these tables the numbers of blonds so nearly equal the numbers of brunettes that the figures have not been reduced to rates per 1,000, since this calculation would not appreciably affect the comparison. As

regards courts-martial and their results, the differences between the two types are immaterial. The numbers of trials are identical, the blonds had an average of 0.3 day more of confinement, but the brunettes received an average of 0.48 dollar more fines. The classifications of the two types according to military character agree as closely as could be expected in groups of this size. As regards change of character an equal proportion of each type underwent no alteration, but of the 16 blonds and 15 brunettes whose character did change, 12 of the blonds deteriorated as compared with 8 of the brunettes. However, the number who changed is so small that it would be unsafe to make deductions therefrom.

In Table XXVII it will be seen that the number of abstainers was practically the same in both types and that the blonds had a larger number of slight drinkers and fewer moderate ones. The number of excessive drinkers was greater among the blonds than among the brunettes (13 as compared with 9). There were 18 admissions for alcoholism and 62 days lost among the blonds as compared with 6 admissions and 31 days lost among the brunettes. The days on sick report from venereal diseases were practically equal for the two complexion types.

SUMMARY OF PART VI.

In summing up it can be said that there was no appreciable difference in behavior between the blonds and the brunettes except in regard to stimulants, the excessive use of alcohol being somewhat more common among the blonds. However, too much weight should not be given to this last conclusion in view of the small numbers of persons who indulged to excess.

PART VII. RELATIVE FREQUENCY OF OCCURRENCE OF SUNSTROKE AMONG BLONDS AND BRUNETTES IN THE UNITED STATES.

The exact causation of sunstroke and heat exhaustion remains in doubt in spite of the many theories advanced by eminent observers. Among these theories may be mentioned that advocated by Maude of the British Army, who considered that sunstroke was due to the action, upon the head, of the actinic rays of the solar spectrum and believed that insolation could be prevented by inserting in the headdress a layer of material impervious to these rays. He employed a red hat lining. In connection with our work on the influence of climate on blonds and brunettes it was desired to obtain statistics as to the complexion type of men suffering from insolation. Such figures could not be obtained in the Philippines, because heat exhaustion is rare and true sunstroke practically unknown in the Archipelago. Therefore, statistics were gathered from the large cities in the United States through the courtesy of the

officials of the institutions enumerated in footnote 6. The results are shown in Table XXVIII.

TABLE XXVIII.—*Numbers of each complexion type among 367 persons suffering from insolation in the United States.*

Group.	Year.	Blonds.	Brunettes.	Mixed types.	Total.
I	1910	9	48	9	66
II	1911	4	65	11	80
III	1911	72	70	87	229

In Groups I and II the separation into complexion types was made by the physicians at the various hospitals, our system of classification having been furnished them. It will be noticed that they placed extremely few in the blond type, perhaps assigning to that class only the most conspicuous examples of blondness. In Group III the physicians were requested to fill out for every case of insolation a printed form which contained among other things the following complexion-type table.

Color of hair.	Color of eyes.	Complexion.
Flaxen.	Light blue.	Light.
Red.	Medium blue.	Ruddy.
Sandy.	Dark blue.	Fair.
Light brown.	Gray.	
Medium brown.	Brown.	Medium.
Dark brown,	Black.	Dark.
Black.		

The physicians prepared one of these blank forms for every patient suffering from insolation, and made a check-mark after the appropriate word in each of the three columns of the complexion-type table. The completed forms were then sent to us and, following the rule used in our work among the soldiers, we classed as blonds those who had the three check-marks above the dividing line, and as brunettes those where all the check-marks were below the line. If some marks were above and some below the man was placed in the class composed of mixed types.

We received 229 of these cards and they are recorded in Table XXVIII as Group III. There were 72 blonds, 70 brunettes, and 87 mixed types. Reduced to a percentage basis, for each 100 blonds there were 97 brunettes. As shown in Table XXIV the proportions of blonds to brunettes among our 10,072 soldiers was as 100 to 86. Therefore, it is clear that the ratio of brunettes suffering from the effects of the sun in the United States was materially higher than the ratio of the same type among 10,072 American soldiers.

SUMMARY OF PART VII.

Unfortunately we have no exact statistics to show what may have been the proportions of the two complexion types in the cities under consideration. Woodruff states that the blonds are less numerous in the cities than in the country. Our Army is recruited from both urban and rural sources and it is doubtful if the figures for complexion type in the cities differ very much from those found in the military service. If this be true, then it is obvious from a study of Group III that the blonds in the United States were not quite as subject to insolation as were the brunettes. If any deductions are to be drawn from Groups I and II, they would be that the harmful effects of the sun are very much less manifest among the fair skinned individuals.

PART VIII. DISCUSSION OF CLIMATIC INFLUENCES AND PIGMENTATION: GENERAL SUMMARY: CONCLUSIONS.

It seems to us by no means proved that the pigmentation of tropical races and the tanning of Caucasians is a protective effort on the part of nature against the chemical activity of sunlight. Several other explanations suggest themselves, but will not be discussed here. The integument of the negro is able to radiate heat more readily than that of a white man, but this advantage is least manifest when most needed, namely in direct sunlight, where the superior radiating power of the black skin is more than counterbalanced by the facility with which the dark colors absorb thermic rays. However, it does seem proven that on the living subject the brown or black skin, when exposed to the sun, is always slightly cooler than the skin of a white man.(4) This apparent anomaly is explained on the ground that the cooling effects produced by evaporation are more marked in the case of the dark races, because of anatomical differences in the skin. Daubler states that the negro has sweat glands which are larger and better developed than those of the Caucasian. Some claim that the number of glands in a given area is greater. Aron considers that the brown skin is cooled more efficiently because the perspiration is secreted more evenly, the evaporation is complete, and the waste, due to the sweat dropping off, is avoided. The above conditions, taken together with the fact that the working native wears very little clothing, place the pigmented native in a better position than the Caucasian as regards the heat regulation of his body in the Tropics.

The advocates of the theory that certain deleterious effects noted in the Tropics are due to the chemical rays of the sunlight, point to sunburn as an evidence of injury produced by actinic rays and maintain

that pigmented skin will absorb these harmful waves.[2][7] The pigmentation following sunburn is considered a conservative effort on the part of the organism. The supporters of the actinic theory advocate the use of protective clothing, a red, orange-red, or black layer being recommended. Some advise a tinfoil lining for the headgear. Now it is a matter of general observation that the covered portions of the body do not become tanned or sunburned when ordinary clothing is worn. If sunburn and tanning are due to actinic rays, and if the usual clothing is able to protect the skin from their effects, it seems to us reasonable to assume that the same clothing will protect the body as a whole from the effects of these rays. This argument of course does not take into consideration that quantity of rays which may enter through the face and hands, but no one, as far as we are aware, has recommended covering these parts. Therefore, it seems probable on theoretical grounds that ordinary clothing gives sufficient protection, and the result of an extensive practical experiment by the Board[10] supported this view by showing that no benefit resulted from the use of orange-red hat linings and underwear.

Recently Aron[4] has shown that monkeys, when exposed to the direct rays of the sun in Manila, quickly develop a high temperature and die in one or two hours. Monkeys exposed under similar conditions, while at the same time a strong current of air from an electric fan blew over their bodies, did not suffer any discomfort. Of course the amount of chemical rays falling on the animals was identical in the two cases. The inability of monkeys to stand sun exposure is considered by Aron to be due to the fact that these animals possess no sweat glands, and consequently have only a limited power of thermic regulation. Therefore, hyperpyrexia occurs as a result of the absorption of solar heat rays. No rise of temperature and no ill results occurred when monkeys' heads were exposed for several days while their bodies were protected from the sun. Aron concludes that "hyperthermia alone must be regarded as the true cause of the death and of the injurious effects brought about by the radiation of the sun." While Aron was working at the Bureau of Science in Manila on the thermic factor in the tropical sunlight, Freer[1] and others have been engaged in the investigation of the chemical side of the problem without producing any results which would show that the actinic rays of the spectrum were distinctly detrimental to man.

The researches of Freer and Aron, the results of the orange-red clothing test by Phalen[10] of this Board, the observations of Wickline[9] on blonds and brunettes and our own work on the same subject render it

very doubtful in our minds whether chemical rays of the sunlight and complexion types of Caucasians are factors of any importance in tropical pathology. The experiences of Gorgas in Panama, the reports of various other workers from many countries, and our own general observations in the Philippines, all lead us to the conclusion that the main cause of tropical deterioration, as seen in the past, was infection of the skin, blood, intestines, and other regions, with those parasites which are more common in the Tropics than in the temperate zone. The vast improvement in the health conditions in Cuba, Panama, and the Philippines, which has followed action based on such a parasitic theory, is strong evidence in favor of our assumption. The enervating effects of continued heat and humidity doubtless play some part, especially in the direction of discouraging out-door exercise. Nostalgia, isolation, and monotony, and the excessive use of alcohol resulting therefrom, are factors of considerable importance. To account for what is observed in the Philippines it does not seem to us necessary to call in the hypothetical action of the actinic rays in the sunlight, nor do we think that there is any adequate evidence that such action is a factor in tropical morbidity and deterioration. It appears that the men who spend much time actively engaged out of doors in the Philippines are the ones who remain in the best health. Those who suffer most from nervous affections are the women, and they pass practically all their time in the shade. The situation is well described by Castellani and Chalmers who state that "the basis of the largest proportion of illness and death in the Tropics is bad sanitation and not climatic influences."(7)

The direful effects of the Philippine climate, which have been so vividly depicted by Woodruff, relate to the earlier days of the American occupation and are not seen at the present time. It is our belief that these unfortunate occurrences were due chiefly to infections resulting from the poor hygienic conditions unavoidable in the early campaigns. It does not seem that any effort is now made to spare officers or men from exposure to the sunlight, yet the morbidity and the mortality continually decrease. Affections of the nervous system, including insanity, are among the diseases considered by Woodruff to be particularly likely to occur in the Tropics, as a result of excessive light stimulation, and he bases his argument on statistics from the reports of the Surgeon-General covering the calendar years 1901 and 1902. To determine if the same argument holds good at the present time, the figures for the last seven years for which statistics are available have been compiled from the reports of the Surgeon-General of the Army and are shown in Table XXIX.

TABLE XXIX.—*Relative admission rates for insanity and for nervous diseases in the Army serving in the Philippines and in the United States, 1903 to 1909.*

Calendar year.	Admission rate per 1,000.			
	Insanity.		Nervous diseases.	
	Philippine Islands.	United States.	Philippine Islands.	United States.
1903[a]	1.05	1.02	22.67	21.77
1904	1.75	1.71	20.34	22.10
1905	1.45	1.61	20.53	19.49
1906	2.02	1.33	19.55	19.47
1907	1.88	1.79	19.32	20.15
1908	1.09	1.58	19.30	18.44
1909	1.56	1.63	16.82	16.61

[a] Figures for the Philippines in 1903 include also those for troops serving in China.

These figures show that there is no constant or essential difference between the admission rates for insanity and nervous diseases in the United States and in the Philippine Islands. In many instances the ratio is higher in the United States. Tables XXI, XXII, and XXV indicate how small a part neurasthenia now plays in the morbidity of Americans in the Philippines. Yet the sunlight is the same as in the period from 1898 to 1902, but the hardships, the bad sanitation, the poor food, the isolation, and the nostalgia have been largely remedied. As stated before, we believe that the most of the neurasthenia here is among the women, who rarely go out in the sun. Among the cases of insanity classified in Table XXV, a very large proportion were considered to have existed at date of enlistment, and not to have been due in any way to the climatic influences of the Philippines.

GENERAL SUMMARY.

It is well known that heat and humidity in an experimental chamber, and in the absence of light, can produce symptoms similar to those occurring in milder degree among residents of the Tropics. We think it probable that these two factors, combined with infections, nostalgia, and monotony, account for most if not all of the injurious effects seen in tropical lands. To explain the conditions met with in the Philippines there seems to be no need for invoking the aid of the actinic rays of the solar spectrum. Protection against these rays by orange-red clothing was of no benefit. It is by no means proved that pigmentation *per se* is beneficial in the Tropics. In our investigations of blonds and

ILLUSTRATION.

Map of Philippine Islands, showing locations where the observations on the blonds and brunettes were carried out.

A STUDY OF THE SYSTOLIC BLOOD-PRESSURE AND THE PULSE RATE OF HEALTHY ADULT MALES IN THE PHILIPPINES.

BASED ON 6,847 BLOOD-PRESSURE READINGS ON 1,489 INDIVIDUALS, AND AN EQUAL NUMBER OF PULSE COUNTS ON THE SAME PERSONS.[1]

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(*From the United States Army Board for the Study of Tropical Diseases.*)

INTRODUCTION.

During the period from January 1, 1909 to September 30, 1911 the Board for the Study of Tropical Diseases carried out in the Philippines two extensive series of observations, one to determine whether Americans of the blond type suffered more than the brunettes from the deleterious influences attributed to the tropical climate(1) and the other to discover whether the wearing of orange-red underclothing, which obstructs the passage of the actinic rays of the solar spectrum, was of any benefit to white soldiers serving in the Archipelago.(2) The compiling and analyzing of the data was done by the Board. A part of the laboratory examinations were made by the Board, but the bulk of the observations were carried out by 24 medical officers of the Army who were specially detailed for the purpose and who worked under the supervision of the Board. As a result of these two series of observations an immense amount of data was collected, which was of value not only in settling the points for which the work was instituted, but also as affording a basis for the study of special features of the physiological activity of the Caucasian when living in the Philippines.

The present report will deal with the subject of blood-pressure in the Tropics and with the associated pulse rate. During the above mentioned observations 6,128 blood-pressure readings and an equal number of syn-

[1] Published with permission of the Chief Surgeon, Philippines Division.

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chronous pulse counts were made on 1,042 white men.[3] Five hundred and fifty-two blood pressure readings and 200 pulse counts were made on 386 Filipinos, most of this work having been done by the Board, but a part by some of the officers mentioned in footnote 3. When the number of observers, all trained in laboratory methods, is considered, it will be obvious that the influence of the personal equation in this work has been reduced to a minimum. The great number of observations enables us to avoid the errors inherent in a small series of cases.

For convenience in reference the men examined in the orange-red underwear tests will be denominated the 1909–Group and those examined during the blond-brunette observations will be referred to as the 1910–Group.

CLASS OF PERSONS EXAMINED.

All of the Caucasians examined were American soldiers, representing a good class of healthy young adults. Diseased men were barred by the stringent physical examination required at the time of enlistment. Furthermore, all the men in both groups were looked over just before the above mentioned observations began and any who appeared to be in ill health were excluded. Very few of the individuals were over 40 or under 20 years of age and none were below 18 years.

The Filipinos examined were from various tribes. One hundred were soldiers of the Philippine Scouts and an equal number were from the Philippines Constabulary. The remainder of the group was made up of laborers, servants, and convicts. With the exception of a few of the convicts, all were under 42 and the majority were less than 30 years of age. A series of 20 Igorots living at Baguio (elevation 1,500 meters) was also examined, but these are not included in the general averages for Filipinos. Both the whites and the great bulk of Filipinos belong to a class of men of good physical development and constantly engaged in vigorous out-of-door work, with no special effort taken to protect them from the sunlight.

CLIMATE AND GEOGRAPHY.

Only brief reference will be made to the climate and geography of the Archipelago where these observations were made, because the subject is dealt with quite fully in another report of the Board.(1) The islands on which the blood-pressure readings were taken extended in latitude from 19° north to 6° north. Except on high mountains the climate is everywhere tropical with a maximum recorded temperature in Manila of 37°.8 C. (100° F.) and minimum of 15° C. (59° F.).

[3] The medical officers who participated in the making of these observations on pulse and blood-pressure were the following: Majors C. C. Collins and Roger Brooke, jr.; Captains C. D. Cowles, G. L. McKinney, H. A. Philips, J. R. Barber, Mahlon Ashford, E. G. Huber, H. M. Snyder, and W. L. Hart; and First Lieutenants Armin Mueller, M. C. Stayer, L. C. Garcia, and C. E. Fronk.

The blood-pressure work on white men was done at 7 points, Camp Stotsenburg, Fort William McKinley, Camp Jossman, Warwick Barracks, Torrey Barracks, Pettit Barracks, and Augur Barracks. Part of the natives were examined at these places, but the majority were tested at Camp Gregg, Corregidor Island, and in Manila. All of the 10 places above mentioned are located on or close to the coast-line and but little above sea level with the exceptions of Camp Stotsenburg and Camp Gregg which are in the interior at altitudes not exceeding 200 meters. The climate at these two last posts does not differ materially from that at the other stations nearer the sea.

BLOOD-PRESSURE APPARATUS AND METHOD OF USE.

The instrument used for all of the tests was the portable form of Doctor Cook's modification of the Riva-Rocci apparatus. The original instrument devised by Doctor Cook had a 4.5-centimeter armlet, which width, according to the experience of most observers, gives readings that are too high.(3) The results are more markedly exaggerated, above what they should be, when the pressure is considerably above normal or when the circumference of the arm is great. Erlanger, v. Recklinghausen, Gallavardin, and Janeway all advocate a 12-centimeter cuff. The instruments with which our routine observations were made had an armlet 8 centimeters in width. In order to reduce the readings made with this 8-centimeter cuff to the basis of a broad armlet we made a series of 140 comparative observations on 60 white men and 288 observations on 120 Filipinos, using with Doctor Cook's apparatus one cuff of a width of 8 centimeters and another of 12.5 centimeters (5 inches). We found that with the 12.5-centimeter cuff the recorded pressure on the average was lower by 8 millimeters for white men, and by 6 millimeters for Filipinos, than was the case when the 8-centimeter armlet was employed. The difference between the results in the two races probably was due to an average smaller circumference for the native arms. In the tables which follow the average readings have all been reduced to the basis of a 12.5-centimeter armlet by deducting 8 millimeters for the whites, and 6 millimeters for the natives, from the averages of the original observations made with the 8-centimeter armlet.

It may be argued that a constant deduction of 8 millimeters would give inaccurate individual results for the very high and for the very low pressures. Even if this be so it would not affect the average figures given in our tables since they are in all cases the average of individual readings on great numbers of men and the 8- or 6-millimeter deduction is the mean difference in a large series of men of the same race, occupation, and physical type.

We applied the cuff to the upper arm and for determining the pressure used as a criterion the return of the pulse wave in the radial artery. Nearly all of our observations were taken with the soldier in the sitting posture. For some individuals the readings were made when the men were reclining, but the numbers so recorded are so small in comparison with the total number of men observed that it would not materially affect the averages even if it be granted that there is a constant slight difference between the readings in the two postures. Erlanger and Hooker found the pressures about the same sitting or lying and Janeway considers the postural variations to be insignificant.(3) Our observations

were made at various hours between 8 a. m. and 4 p. m. Those observations on white men which are included in the general averages were in many cases taken after the soldier had been performing his usual military duties, such as drill or fatigue. In a special group, not included in the general averages and which will be described later, the blood-pressure readings and pulse counts were made as soon as possible after vigorous exercise. In the case of the natives all pressures were taken when the men had no exercise immediately preceeding the observations.

The observations on the 1909–Group continued for ten months, blood-pressure readings being taken for each man on 4 occasions during that period, the time between readings being about three months. In the 1910–Group, 5 blood-pressure observations were made on each individual, 1 at the commencement of a 12-month period, 1 at its end and the 3 others at quarterly intervals. In Tables II, III, IV, V, and XIII the average readings are made up from the combined 4 or 5 quarterly observations taken on each man and so represent the *mean annual blood-pressure.* Therefore, it is obvious that the disturbing influence of such factors as excitement, alcoholism, temporary indisposition, the ingestion of food, or the taking of exercise, is reduced to a minumum and that the average for each individual must represent very accurately his normal blood-tension.

STANDARD OF NORMAL BLOOD-PRESSURE IN TEMPERATE CLIMATES.

The wide variations in normal blood-pressure which have been recorded by different writers are probably due largely to the use of armlets varying in width. Janeway states that in young adult males the systolic pressure ranges from 100 to 130 millimeters of mercury when a 12-centimeter armlet is nsed. Gallawardin(4) considers the ordinary mean to lie between 110 and 120 millimeters. A very valuable series of statistics was published in 1910 by Woley.(5) He analyzed the blood-pressures of 1,000 supposedly healthy individuals, using a 12.5-centimeter (5-inch) cuff applied to the arm when the subject was in the sitting posture. He found the average systolic pressure for all males to be 127.5 millimeters and for all females 120 millimeters. Classifying his 1,000 cases according to age he obtained the following results:

TABLE I.—*Woley's average systolic blood-pressures for 1,000 healthy persons in the United States. (12.5-centimeter armlet.)*

Range of age.	Average pressure.	Range of age.	Average pressure.
Years.	*mm.*	*Years.*	*mm.*
15 to 30	122	40 to 50	130
30 to 40	127	50 to 60	132

Faught considers the average normal systolic pressure at the age of 20 to be 120 millimeters.(9) Bachmann(7) examining healthy students

in Philadelphia with a 10-centimeter cuff found an average pressure of 114.3 millimeters for a series of 10 boys ranging from 15 to 20 years of age; 119 millimeters for 53 men ranging from 21 to 30 years; and 120 for 9 individuals ranging from 31 to 40 years.

Most of the older statistics for blood-pressure on healthy persons are based on readings made with narrow, constricting bands like the 5-centimeter armlet used with the early Riva-Rocci apparatus. Such figures are always too high.

The figures given above indicate that in the temperate zone and with a wide armlet the mean blood-pressure for healthy men from 15 to 30 years of age should be looked for between the limits of 115 and 120 millimeters, certainly not above 122 millimeters.

INFLUENCE OF TROPICAL CLIMATE ON BLOOD-PRESSURE AND PULSE RATE.

The average blood-pressure with the 12.5-centimeter armlet, based upon 5,368 readings on 992 American soldiers serving in the Philippines, was 115.6, and the pulse rate for a like number of observations on the same men was 81 per minute. These men ranged in age from 18 to 50 and the average was 26.6 years. The average length of their present tour of tropical service was about eleven months at the *beginning* of the year during which the men were under observation. Table II shows the details of these observations.

TABLE II.—*Average systolic blood-pressures and pulse rates, based on 5,368 observations of each which were made on 992 American soldiers serving in the Philippines; arranged according to age. (12.5-centimeter armlet.)*

Age period, years.	Average age, years.	Number of men showing pressures from—							Total number of men.	Average pressure.	Average pulse rate.
		91 to 100 mm.	101 to 110 mm.	111 to 120 mm.	121 to 130 mm.	131 to 140 mm.	141 to 150 mm.	151 to 160 mm.			
										mm.	
18 to 20	19.4	1	12	13	8	1	1	-----	36	115.0	78
20 to 25	22.8	32	156	165	87	22	5	2	469	114.3	82
25 to 30	27.2	16	73	108	70	13	3	3	286	115.9	81
30 to 35	32.6	2	34	42	23	7	1	------	109	116.7	80
35 to 40	37.5	------	9	24	14	8	3	------	58	120.5	81
Over 40	43.1	2	3	17	7	2	2	1	34	119.6	79
Totals or averages	26.6	53	287	369	209	53	15	6	992	115.6	81

It will be seen from the above table that the blood-pressures for the ages from 18 to 30 average 115 millimeters, which is 7 millimeters lower than Woley found and 3 millimeters lower than Bachmann found for the same age period in the United States. However, it is exactly midway in the normal range set by Gallavardin and Janeway for temperate

climates. For the period from 30 to 40 years our average was 118 millimeters, which is 9 millimeters lower than Woley's but only 2 millimeters lower than Bachmann's experience for the same ages. The pulse rate for all ages was 9 beats above the accepted normal for temperate climates.

INFLUENCE OF LENGTH OF TROPICAL RESIDENCE ON BLOOD-PRESSURE AND PULSE RATE.

Since the number of men who had lived over a year in the Philippines was considerably greater for the 1909–Group than it was for the 1910–Group these two groups have been tabulated separately according to length of tropical service in Tables III and IV, as well as combined in Table V. The average age of the men in the group for each quarterly period of tropical service has also been given because age has a distinct bearing on blood-pressure. As stated above, our complete series of blood-pressure observations consisted of 4 or 5 readings for each individual, evenly spaced through a year, but in the next 3 tables only the *first* of these readings has been considered and the figures in the first column of each of the 3 tables indicate the number of months intervening between the date of arrival in the Philippines and date of the initial blood-pressure reading for each soldier in the sub-group.

TABLE III.—*Average systolic blood-pressures and pulse rates for 587 men of the 1909–Group, arranged by length of Philippine residence. (12.5-centimeter armlet.)*

Length of tropical residence.	Number of men.	Average pressure.	Average pulse.	Average age.
		mm.		
3 months or less	76	110	75	23.8
3 to 6 months	14	118	78	26.1
6 to 9 months	123	112	76	24.3
9 to 12 months	232	118	89	24.0
12 to 15 months	47	118	77	24.6
15 to 33 months	26	122	79	30.0
33 to 36 months	22	119	83	30.5
Over 36 months	47	120	84	33.3

TABLE IV.—*Average systolic blood-pressures and pulse rates for 404 men of the 1910–Group, arranged by length of Philippine residence. (12.5-centimeter armlet.)*

Length of tropical residence.	Number of men.	Average pressure.	Average pulse.	Average age.
		mm.		
3 months or less	158	116	77	27.0
3 to 6 months	74	120	80	27.0
6 to 9 months	88	117	75	27.2
9 to 12 months	59	113	73	30.3
Over 12 months	25	124	77	33.3

TABLE V.—*Average systolic blood-pressures and pulse rates for 991 men, the combined 1909-Group and 1910-Group, arranged by length of Philippine residence.* (*12.5-centimeter armlet.*)

Length of tropical residence.	Number of men.	Average pressure.	Average pulse.	Average age.
		mm.		
3 months or less	234	114	76	23.2
3 to 6 months	88	120	80	26.9
6 to 9 months	211	114	76	25.7
9 to 12 months	291	117	85	25.7
Over 12 months	167	120	80	29.9

It will be observed that in all 3 tables the blood-pressure is lower during the first three months of tropical residence than at any subsequent time, with two exceptions. The variations between the average readings for the different quarterly periods are slight, rarely exceeding 6 millimeters, and there seems to be no consistent rise or fall of pressure with increasing length of tropical service. The fact that the last readings in Tables IV and V and the last 3 in Table III are rather higher than the earlier ones can best be explained by consulting the column of ages, when it will be seen that the average age of the men for these periods was considerably higher than for those who had served shorter terms in the Philippines. The reason of this is that most of the individuals who stay longer than two years in the Archipelago are old soldiers, desirous of taking advantage of the fact that Philippine duty counts as double time in reckoning the thirty years of service necessary for retirement. Pulse rates in all the 3 tables are somewhat elevated above the average for the temperate zone, but there is no indication that increasing length of service aggravates the tendency to undue rapidity of heart action.

Tables VII and VIII show that during a period of one year, throughout which observations were made quarterly, there was no progressive alteration in blood tension and that the pressure was not materially different at the beginning and at the end of this year of observation.

Musgrave and Sison(6), working in Manila and using the Erlanger instrument with a 12.5-centimeter armlet, found among 97 foreigners, mostly Americans from the Civil Service and the United States Army, that the blood-pressures were as shown in Table VI.

TABLE VI.—*Average systolic blood-pressures of 97 foreigners in Manila, according to Musgrave and Sison.* (*12.5-centimeter armlet.*)

Length of residence.	Pressure.
Years.	*mm.*
1 or less.	124
1 to 5	115
5 to 10	116
Over 10	113

It will be observed that Musgrave and Sison did not obtain readings during the first twelve months which were as low as ours. Their figures after one year of tropical residence coincide with what we found during the first year. In their article these observers conclude that blood-pressure in the Tropics is materially reduced. In view of the standards for temperate climates recognized by Janeway,(3) Gallavardin,(4) Woley,(5) and Bachmann(7) it seems to us that the average pressure of 124 millimeters found by Musgrave and Sison (with a 12.5-centimeter armlet) is not low and that even the average of 115 millimeters could not be considered so low as to be of much significance.

SUMMARY OF INFLUENCE OF THE PHILIPPINE CLIMATE.

Reduced to the basis of a 12.5-centimeter armlet we found the average blood-pressure for healthy white men in the Philippines to be 115 millimeters for those between 15 and 30 years of age and 118 millimeters for those from 30 to 40 years old. These figures are little if any below those to be expected in a temperate climate when a 12.5-centimeter cuff is employed. The lowest readings were obtained in the first three months of Philippine service. There was no progressive tendency for the pressure to increase or to decrease with continued tropical residence up to a little over three years, beyond which point our observations do not extend. The pulse rate was constantly increased, averaging 9 beats above the usual standard of 72 per minute.

INFLUENCE OF SEASON ON THE BLOOD-PRESSURE AND PULSE RATE.

The hottest part of the year in the regions where our observations were made is in the second quarter, April, May, and June. The rains usually begin in June or July and last till October or November. December, January, and February are comparatively cool with a mean temperature of about 25° C. (77° F.). Tables VII and VIII have been prepared to show the influence of season on the blood-pressure and pulse rate. It should be noted that in the 1909–Group the observations began in the first quarter of the calendar year whereas in the 1910–Group they commenced in the second quarter. The individual observations could not of course all be made on the same date. In fact they are spread over a period of about six weeks, but the majority were made in the middle month of the designated quarter.

TABLE VII.—*Average systolic blood-pressures and pulse rates for 587 men of the 1909–Group, the 4 observations on each man being arranged by season. (12.5-centimeter armlet.)*

Observation.	First quarter 1909.	Second quarter 1909.	Third quarter 1909.	Fourth quarter 1909.
Blood-pressure ---------- millimeters	116	111	114	116
Pulse rate ----------	82	88	87	83

TABLE VIII.—*Average systolic blood-pressures and pulse rates for 404 men of the 1910–Group, the 5 observations on each man being arranged by season. (12.5-centimeter armlet.)*

Observation.	Second quarter 1910.	Third quarter 1910.	Fourth quarter 1910.	First quarter 1911.	Second quarter 1911.
Blood-pressure ..... millimeters..	117	118	118	118	118
Pulse rate	77	77	78	77	77

In the 1909–Group it will be seen that there was a drop in pressure of 5 millimeters in the second quarter and of 2 millimeters in the third quarter of the calendar year. The months during which the marked reduction of 5 millimeters occurred are the hottest of the year. In the 1910–Group there was a decrease of 1 millimeter in the second quarter, 1910. If the two groups were combined the mean drop in the second quarter would be about 3 millimeters. It appears, therefore, that there is a slight but probably unimportant alteration in blood-pressure in the Philippines as a result of the seasonal changes. The pulse rate was unaltered throughout the year in the 1910–Group, but showed an increased rapidity of 5 or 6 beats per minute during the hottest period in the 1909–Group.

INFLUENCE OF AGE ON BLOOD-PRESSURE AND PULSE RATE.

It will be seen on consulting Table II that there was a fairly well marked tendency for the blood-pressure to increase with age, the average for the period 18 to 20 years being 115.0 while that for the period 35 to 40 years was 120.5. The subgroup over 40 years of age contained no man over 50 and the average age for the group was only 43.3 years, which probably accounts for the fact that higher readings were not encountered in this subgroup. Increasing age produced no constant alteration in the pulse rate.

These changes in pressure with advancing years correspond with the experience of observers in the temperate climates. The degree of increase found in our series for men below 40 years of age was rather less marked than that found by Woley in Chicago and Bachmann in Philadelphia. Our number of men over 40 years old is too small to be of value in giving average results.

INFLUENCE OF COMPLEXION ON BLOOD-PRESSURE AND PULSE RATE.

As stated in the introduction we have been carrying out a series of observations to determine if blonds were more susceptible than brunettes to the influence of the Tropics. Pulse and blood-pressure observations formed a part of this work and the results are shown in Tables IX and X.

TABLE IX.—*Comparative average systolic blood-pressures and pulse rates for 111 blonds and 118 brunettes, 1909–Group. (12.5-centimeter armlet.)*

Type.	Average age.	First quarter 1909.		Second quarter 1909.		Third quarter 1909.		Fourth quarter 1909.		Average for year.	
		Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.
	Years.	*mm.*		*mm.*		*mm.*		*mm.*		*mm.*	
Blond	25.5	116	82	113	93	114	89	117	85	114.8	87.2
Brunette	25.1	119	86	115	92	115	94	118	86	116.8	89.2

TABLE X.—*Comparative average systolic blood-pressures and pulse rates for 206 blonds and 198 brunettes, 1910–Group. (12.5-centimeter armlet.)*

Type.	Average age.	Second quarter 1910.		Third quarter 1910.		Fourth quarter 1910.		First qurater 1911.		Second quarter 1911.		Average for year.	
		Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.
	Years.	*mm.*		*mm.*		*mm.*		*mm.*		*mm.*		*mm.*	
Blond	27.4	116	77	119	78	118	78	117	77	118	77	117.6	77.3
Brunette	28.1	118	78	117	77	118	78	118	77	117	77	117.6	77.3

It will be observed that the average pressures throughout the year for the blonds and brunettes of the 1910–Group are identical while in the smaller 1909–Group the difference is only 2 millimeters of mercury. If the two groups are combined we obtain an average for 317 blonds of 116.7 millimeters and for 316 brunettes of 117.3 millimeters a difference of only 0.6 millimeter. The pulse rate for the two complexion types is the same in the 1910–Group and varies only 2 beats in the 1909–Group. Therefore it can be concluded that the complexion type does not appreciably affect the blood-pressure or the pulse rate in the Tropics when men are at rest. To determine if there was a difference after exercise we had special observations on the pulse and blood-pressure taken on two occasions, once near the beginning and once near the end of the year of observation. The results appear in Table XI.

TABLE XI.—*Comparative average systolic blood-pressures and pulse rates on 136 blonds and 124 brunettes of the 1910-Group after exercise. (12.5-centimeter armlet.)*

Type.	Second quarter 1910.		Second quarter 1911.		Average for two observations.	
	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.
	mm.		*mm.*		*mm.*	
Blond	125.4	85.9	123.8	82.7	124.6	84.3
Brunette	128.2	87.4	125.7	83.8	127.0	85.6

These observations were made as soon as possible after the men had completed a march, a period of drill, or some other form of exercise

carried on out of doors. The exercise was as far as practicable the same for the two complexion types. On comparing the table with the preceding one, which deals with the same men when at rest, it is clear that the result of exercise was to raise the blood-pressure by an average of from 7 to 9 millimeters, and the pulse rate by an average of 7 beats. This is what would be expected in the case of healthy well-trained men engaged in moderate out-door work. When we come to compare the two complexion types it will be seen that both pulse rate and blood-pressure are slightly higher for the brunettes. However, the average differences are so small that they are probably of no importance, and it is our opinion that variation in complexion does not produce any significant change in the blood-pressure and pulse rate either at rest or during exercise.

INFLUENCE ON THE BLOOD-PRESSURE AND THE PULSE RATE OF THE USE OF ORANGE-RED UNDERWEAR AND HAT LININGS.

Table XII was prepared as a part of the data which went to show that orange-red under-garments and hat linings for use in tropical countries were of no value.

TABLE XII.—*Comparative average systolic blood-pressures and pulse rates for 294 men wearing orange-red garments and 294 men wearing white ones, 1909–Group. (12.5-centimeter armlet.)*

Clothing.	Average age.	First quarter 1909.		Second quarter 1909.		Third quarter 1909.		Fourth quarter 1909.		Average for year.	
		Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.	Pressure.	Pulse.
	Years.	*mm.*		*mm.*		*mm.*		*mm.*		*mm.*	
Orange-red	25.4	115	82	111	88	112	88	115	83	113.6	85.1
White	25.4	117	82	112	89	115	87	117	83	115.0	85.2

Exposure to ultra-violet rays is said to lower blood-pressure and some have considered the sunlight in the Tropics to be richer in these rays than it is in temperate regions. If such be the case it is conceivable that the protection of the greater part of the body with a color which intercepts the actinic rays of the solar spectrum might have some effect on the blood-pressure. The experiment showed a lower blood-pressure for those wearing the orange-red garments, but the difference is so slight that, in our opinion, it should be attributed to chance rather than to the influence of the clothing. At the different quarterly periods the pressure of the orange-red group ranged from 1 to 3 millimeters lower, and for the entire year the average for the orange-red group was 1.4 millimeters lower than for the white. Such slight differences are of no significance. The averages for the pulse rate throughout the year varied by only 0.1 of a beat.

INFLUENCE OF INDIVIDUAL SIZE OF THE MEN ON THE BLOOD-PRESSURE AND PULSE RATE.

Since the heights and weights of all of the soldiers in our series were on record it seemed an excellent opportunity to investigate the influence of individual size on blood-pressure, a phase of the subject in regard to which few data are available. In addition to the 992 soldiers for each of whom we had an average pressure, deduced from 4 or 5 readings taken at intervals during a year, there were a number of other men for whom 1, 2, or 3 pressure readings had been taken and the observation then discontinued for one reason or another. The individual averages for these men have been combined with the averages for the 992 previously considered, making a total of 1,243 men on whom 5,775 blood-pressure readings had been made. These men were then divided into groups according to height in inches. The results are shown in Table XIII.

TABLE XIII.—*Average systolic blood-pressures and pulse rates, based on 5,775 observations of each made on 1,243 healthy soldiers in the Philippines, arranged according to height. (12.5-centimeter armlet.)*

Range of height.	Average weight.			Number of men.	Average pressure.	Average pulse.	Average age.	Average tropical service.
	Cm.	*Lbs.*	*Kgms.*		*mm.*		*Years.*	*Months.*
Under 64 inches	162.5	132.9	60.4	27	117.9	79.0	27.6	13.4
64 inches[a]	162.5	134.7	61.2	114	114.7	80.3	26.7	17.1
65 inches	165.0	139.9	63.6	157	116.0	80.0	26.0	15.9
66 inches	167.6	141.9	64.5	187	115.5	81.5	27.2	17.2
67 inches	170.1	144.4	65.6	225	116.2	80.4	26.7	16.8
68 inches	172.7	147.2	66.9	251	115.7	82.3	26.4	17.8
69 inches	175.2	152.7	69.4	127	116.2	82.6	26.2	16.1
70 inches	177.7	155.6	70.7	80	117.9	80.2	27.1	16.0
71 inches	180.3	159.0	72.3	40	119.3	81.5	26.6	15.2
72 inches and over	182.8	164.5	74.8	35	120.6	83.0	25.8	17.6
Averages		145.5	66.1		116.2	81.2		

[a] This means that the men in the group were 64 inches or more, but less than 65. The next figure means that they were 65 or more, but less than 66. The same explanation applies to the subsequent figures.

It is to be observed in Table XIII that the weight progressively increased with the height and that the average age and the average length of tropical service did not vary materially in any of the height groups. Therefore any difference in blood-pressure observed may safely be attributed to the influence of height and weight. It is plain that there is no progressive rise of blood-pressure with increasing size up to and including 70 inches (177.7 centimeters) in height. For the groups 71 inches (180.3 centimeters) and over 72 inches (182.8 centimeters) there does appear a tendency for the blood-pressure to rise 2 or 3

millimeters, but these groups are relatively small so that the slight increase in pressure may have been due to chance. On the whole it can be said that there is no clearly marked tendency for either pulse or blood-pressure to rise with increasing height and weight of the individual.

INFLUENCE OF RACE ON BLOOD-PRESSURE AND PULSE RATE IN THE TROPICS.

In order to determine the blood-pressure of healthy adult Filipino males 552 observations were made on 386 Filipinos. Several tribes were represented such as Tagalogs, Ilocanos, Macabebes, and Visayans, but they did not differ essentially in physique, habits, or character of residence. Two hundred were soldiers and the remainder servants, laborers, and convicts. Most of the observations were made by the Board, but a part were by the officers referred to in footnote 3. The majority of these observations were taken with an 8-centimeter armlet. For the observations on 120 Filipinos the pressures were taken with both a 12.5-centimeter and an 8-centimeter armlet, and it was found that the latter registered 6 millimeters higher than the former. This amount has accordingly been deducted from the average of the readings made with the 8-centimeter cuff.

The average blood-pressure, on a basis of a 12.5-centimeter armlet, for 100 soldiers of the Philippine Scouts was 115.0 millimeters and for 100 soldiers of the Philippines Constabulary was 115.9 millimeters. In both groups the ages ranged from 15 to 40 and the average age was 24.7 years for the Scouts and 25.2 years for the Constabulary. For 145 Filipinos from various sources, ranging from 15 to 40 years of age and averaging 24.1 years, the average pressure was 115.7 millimeters. When using the *actual* 12.5-centimeter armlet the average of 166 readings on 120 Filipinos, ranging in age from 15 to 40 years, was 116.7 millimeters. *We may therefore conclude that the mean blood-pressure for Filipinos during the period of 15 to 40 years of age (average about 25 years) is 115 or 116 millimeters and that it does not differ from the pressure at the same ages for Americans residing in the Philippines. For neither race is it very materially below the figures to be expected for white men residing in temperate climates.*

Musgrave and Sison(6) obtained decidedly lower pressures in a series of 49 Filipinos, for whom the age limits are not stated. These observers found an average of 108 millimeters for 30 males and 113 for 19 females. We do not think that any general deductions should be drawn from such a small series. It is very likely that chance may have been an important factor in producing these low readings, especially in view of the fact that the usual relationship of pressures for the two sexes was reversed, the females having the higher tension, whereas the general experience elsewhere is that women show a systolic pressure lower by about 10 millimeters.(3)

Two small groups among our Filipinos, which are not included in the above consideration, are of interest. One is a group of 26 Filipinos ranging in age from 40 to 75 years, the average being 50.6 years. The mean pressure was 144.8. This seems a high figure, considering the average age, and possibly may signify that the elevation from increasing years comes on earlier for Filipinos than for white men. Casual observation suggests that the other indications of senility occur early among tropical natives. The other group consists of 20 Igorots, all apparently young, but whose exact ages could not be determined. They gave an average of 122.0 millimeters. The Igorots were living at an altitude of 1,500 meters in a comparatively temperate climate, and though smaller in stature are better developed physically than the lowland natives. Their blood-pressures averaged 6 or 7 millimeters higher than the mean for the lowland Filipinos, the increase probably being due to the altitude.(8) The whole Filipino group, except the Igorots, is arranged by ages in Table XIV.

TABLE XIV.—*Average systolic blood-pressures for 366 lowland Filipinos; arranged by ages. (12.5-centimeter armlet.)*

Age period.	Number of men showing pressures from—									Total number of men.	Average pressures.
	80 to 90 mm.	91 to 100 mm.	101 to 110 mm.	111 to 120 mm.	121 to 130 mm.	131 to 140 mm.	141 to 150 mm.	151 to 160 mm.	161 to 200 mm.		
											mm.
15 to 20 years		4	11	18	6	1				40	112.8
20 to 25 years	1	10	49	59	28	8	3	2	1	161	115.4
25 to 30 years		7	21	32	23	9	2	1		95	117.0
30 to 35 years	1	2	6	5	10	3	1			28	116.9
35 to 40 years	1	1	5	5	3	1				16	112.3
Over 40 years			4	4	1	4	1	6	6	26	144.8
Total	3	24	96	123	71	26	7	9	7	366	

It will be seen that the blood-pressure showed a tendency toward progressive increase with age except in the period 35 to 40 years. The records for this period contained 5 exceptionally low blood-pressure readings and as there were in all only 16 men in this subgroup it is probable that such a low reading for the ages of 35 to 40 is merely the result of accident and would not be manifest in a larger series. Pulse rates were recorded only for the Scout and Constabulary groups and averaged for the former 75.7 (blood-pressure 115.0 millimeters) and for the latter 82.5 (blood-pressure 115.9 millimeters). These averages do not vary materially from the pulse rates found for our various groups of American soldiers in the Philippines.

CONCLUSIONS.

1. The mean blood-pressure in temperate climates for healthy males between 15 and 30 years of age lies between 115 and 122 millimeters of mercury when a 12.5-centimeter armlet is employed.

2. When the 12.5-centimeter armlet is used the blood-pressure of American soldiers serving in the Philippines averages 115 millimeters for the period 18 to 30 years of age, and 118 for the period 30 to 40 years.

3. This indicates that the blood-pressure of Americans residing in the Philippines differs but little if any from the average at home.

4. Usually the lowest readings for Americans living in the Philippines were obtained in the first three months of tropical residence, but there was no progressive tendency for the pressure average to rise or to fall with increased length of residence up to a limit of three years, beyond which our work did not extend.

5. The blood-pressure of Americans was lower during the hottest part of the year, but the difference was very slight, only about 3 millimeters.

6. There was a well marked tendency for the blood-pressure of Americans to rise with increasing age.

7. Neither complexion type nor the use of underwear and hat linings of orange-red color exerted any appreciable influence on the blood-pressure of American soldiers.

8. There was no well marked tendency for the blood-pressure or pulse rate to rise with increasing height and weight of the individual.

9. As was to be expected, exercise raised both the blood-pressure and the pulse rate.

10. Using a 12.5-centimeter armlet the average blood-pressure of Filipinos was found to be 116 millimeters for a large group of males ranging from 15 to 40 years of age and averaging 25 years. This pressure was practically identical with that for the group of white men of the same average age and living in the Philippines.

11. There is a well marked tendency for the blood-pressure of Filipinos to rise with increasing age.

12. The pulse rate of active Filipinos and Americans living in the Philippines averages a few beats above the usual standard of 72 per minute.

In closing we wish to express our obligations to the medical officers mentioned in footnote 3, who by their earnest and continued efforts made possible the collection of the statistics on which this report is based.

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THE RED BLOOD CORPUSCLES AND THE HÆMOGLOBIN OF HEALTHY ADULT AMERICAN MALES RESIDING IN THE PHILIPPINES.

BASED ON 1,418 RED CELL COUNTS AND 1,433 HÆMOGLOBIN ESTIMATIONS PERFORMED ON 702 SOLDIERS.[1]

By WESTON P. CHAMBERLAIN.[2]

(*From the United States Army Board for the Study of Tropical Diseases.*)

The expression "tropical anæmia" in one that often occurred in the older treatises on diseases of hot countries, but more recent investigations have shown that most of the conditions formerly so designated are in reality instances of secondary anæmia due to infections with various parasites, notably plasmodia and uncinaria.

Scheube says "there is no anæmia caused by the tropical climate alone."(1) The investigations of Marestang, van der Scheer, Eijkman, Glongner and F. Plehn(1) on white men living in the Tropics showed no material deviations from the normal condition as observed in Europe. Castellani and Chalmers(2) state that a certain number of Europeans in the Tropics take on "a peculiar whitish color, even in cases in which the blood examination does not reveal any sensible decrease in the amount of hæmoglobin." Eijkman(1) also refers to this phenomenon. Lehmann and van der Scheer(1) and Musgrave and Sison(3) consider this pallor of the skin to be a local vaso-motor condition.

In 1908 Wickline(4) reported the result of examinations of the blood of American soldiers in the Philippines. The men arrived in the Archipelago in June, 1905, and the first observations were made in September of the same year. His results, which are given in Table I, showed that there was a progressive fall in the percentage of hæmoglobin and a regular rise in the number of erythrocytes except at the last observation period. The color index progressively decreased.

TABLE I. *Wickline's average estimations of the erythrocytes and hæmoglobin of American officers and soldiers who arrived in the Philippines in June, 1905.*

Number of men examined.	Dates of examination.	Average number of erythrocytes per cubic millimeter.	Average hæmoglobin.	Average color index.
			Per cent.	
70	Sept., 1905	4,980,555	94	0.94
104	Dec., 1905	5,343,595	89	0.83
97	Aug., 1906	5,429,960	86	0.79
81	Apr., 1907	5,330,888	83	0.78

[1] Published with permission of the Chief Surgeon, Philippines Division.

[2] Weston P. Chamberlain, major, Medical Corps, United States Army, president of the United States Army Board for the Study of Tropical Diseases as they Exist in the Philippine Islands.

During the last three years the United States Army Board for the Study of Tropical Diseases has been carrying out two series of observations, one to determine if any benefit resulted from the use of orange-red underwear in the Philippines,(5) and the other to decide if complexion type was a factor in the resistance of white men to tropical influences.(6) During this work a large number of observations on the blood were made by the members of the Board and by certain medical officers of the Army who were detailed to make the examinations under the supervision of the Board.[3] The large number of independent observers minimizes as far as possible the influence of the personal equation in this work. The red cells were counted with the Thoma-Zeiss hæmocytometer. The hæmoglobin estimations were made in most cases with Dare's hæmoglobinometer and in the remainder with the von Fleischl instrument. The number of men observed is so large that the element of chance is eliminated. With one exception the stations where the soldiers resided were close to the coast line. Most of them were near sea-level and of the posts which were not so situated none were at an altitude exceeding 600 feet (200 meters). It should be understood that all of the men were healthy soldiers performing their full military duty. The results are shown in Tables II and III. The average age of the men in Table II was 25.3 years and of those in Table III was 27.7 years.

TABLE II.—*Average erythrocyte counts and hæmoglobin estimations on 65 American soldiers who at the date of the first examination had served on the average 14.9 months in the Philippines.*

Dates of examinations.	Average number of erythrocytes per cubic millimeter.	Average hæmoglobin.	Average color index.
		Per cent.	
January, 1909	5,276,000	89.3	0.85
July, 1909	5,355,000	88.2	0.82
December, 1909	5,152,000	90.0	0.87

[3] The medical officers who were engaged in making the blood examinations referred to in this sentence were the following: Majors A. E. Truby and Roger Brooke, jr.: Captains E. G. Bingham, J. R. Barber, Mahlon Ashford, E. G. Huber, H. M. Snyder, and W. L. Hart; 1st Lieutenants J. B. H. Waring, W. R. Dear, C. E. Doerr, F. S. Wright, C. G. Snow, N. L. McDiarmid, Armin Mueller, T. J. Leary, M. C. Stayer, L. C. Garcia, and C. E. Fronk, Medical Corps; and 1st Lieutenants W. F. de Niedman, and C. A. Betts, Medical Reserve Corps.

TABLE III.—*Average erythrocyte counts and hæmoglobin estimations on 601 American soldiers who at the date of the first examination had served on the average 6.6 months in the Philippines.*

Dates of examinations.	Average number of erythrocytes per cubic millimeter.	Average hæmoglobin.	Average color index.
		Per cent.	
May and June, 1910	5,111,000	90.3	0.88
May and June, 1911	5,206,000	89.6	0.86

It will be seen that in character our blood examinations agree with those of Wickline, although the alteration which he found with increasing length of tropical residence are not as pronounced in our series as in his. Our average erythrocyte counts at different periods range from 5,111,000 to 5,355,000, and the average hæmoglobin readings from 88 to 90 per cent. The color index is consequently considerably below unity, varying from 0.82 to 0.88.

In Tables IV and V is shown the range covered by the individual red counts and hæmoglobin estimations for a body of healthy American soldiers, who at the date of examination had served in the Philippines for an average of twenty months, the length of this service being for no man less than fourteen months. These tables include all the examinations that are shown in the last column of averages in Tables II and III, together with a few others which were not entered in Tables II and III because there were no preliminary examinations for the individuals concerned.

TABLE IV.—*Range of erythrocyte counts for 687 healthy American soldiers who at date of count had served on the average twenty months in the Philippines.*

Range of erythrocyte count per cubic millimeter.	Number of men.	Per cent of total number.	Range of erythrocyte count per cubic millimeter.	Number of men.	Per cent of total number.
Under 4,000,000	15	2.2	5,500,000 to 5,749,000	76	11.1
4,000,000 to 4,249,000	26	3.8	5,750,000 to 5,999,000	39	5.6
4,250,000 to 4,499,000	37	5.4	6,000,000 to 6,224,000	35	5.1
4,500,000 to 4,749,000	60	8.8	6,225,000 to 6,499,000	24	3.5
4,750,000 to 4,999,000	112	16.3	6,500,000 to 6,749,000	12	1.7
5,000,000 to 5,224,000	155	22.5	6,750,000 to 6,999,000	14	2.1
5,225,000 to 5,499,000	77	11.2	Over 7,000,000	5	0.7

TABLE V.—*Range of hæmoglobin readings for 702 healthy American soldiers who at date of examination had served on the average twenty months in the Philippines.*

Range of hæmoglobin.	Number of men.	Per cent of total number.	Range of hæmoglobin.	Number of men.	Per cent of total number.
Under 80 per cent	8	1.1	90 to 94 per cent	261	37.2
80 to 84 per cent	64	9.2	95 to 99 per cent	136	19.4
85 to 89 per cent	185	26.4	100 per cent or over	48	6.7

It will be noted in the erythrocyte counts that there was a considerable excursion below and a still greater excursion above the 5,000,000 mark. The men with cell counts between 5,000,000 and 6,000,000 per cubic millimeter constituted 50.4 per cent of the total 687, while those with counts above 6,000,000 formed 13.1 per cent. The table of hæmoglobin estimations shows that 89.7 per cent of the men gave readings of 85 per cent or upward.

The normal erythrocyte count of young adult males at sea-level in temperate climates may vary considerably from the conventional 5,000,000 per cubic millimeter. Cabot states that 6,000,000 is by no means rare among healthy young men and that higher figures are seen occasionally. Among 50 young medical students in the United States Hewes(7) found an average of 5,809,000, the lowest being 5,120,000. Sorensen (11) found an average of 5,606,000 for male students ranging from 19.5 to 22 years of age and of 5,340,000 for young physicians from 25 to 30 years old. Ewing,(8) speaking of Welcker's estimate of the normal red cell count as 5,000,000 for men and 4,500,000 for women, says:

"Perhaps the chief contribution of later observers using Thoma's instrument has been the proof that the numbers are more apt to exceed rather than fall below these averages, especially in men, a fact that has become more certain from the more careful estimates of the last decade. Thus the average obtained by Helling was 5,910,000; by Frederickson, 5,072,000; Zaslein, 5,010,000; Neubert, 5,603,000; Graber, 5,081,000; Stierlin, 5,752,000; Reinicke, 5,209,667; Andriezen, 6,000,000; Hayem 5,500,000."

In view of the above averages it will be seen that the erythrocyte counts obtained by Wickline and by ourselves among healthy young soldiers in the Philippines could not be considered as differing from the normal as seen in Europe and America.

For 70 healthy American soldiers stationed in New Orleans, and in whom uncinariasis had been ruled out by repeated examinations of the stools, we found an average of 94.2 per cent of hæmoglobin.(12) The von Fleischl instrument was used and the average age of the men was about 28 years. Our own experience elsewhere in the United States has been that readings with this instrument rarely reach 100 per cent.

Faught(10) considers 90 or 95 per cent with the von Fleischl apparatus to be normal. The relative percentage of hæmoglobin as estimated by clinical hæmoglo-

binometers, is figured by Stierlin(9) to be 88.8 for the ages 18 to 25 years and 100.0 for the ages 25 to 45 years. Since the average age of the groups of men we examined was 25.3 years for that considered in Table II and 27.7 years for that in Table III, it will be seen that the hæmoglobin percentages, which ranged from 88 to 90, were probably a little below the standard to be expected in the temperate zone. In the case of Wickline's series the reduction of hæmoglobin was more marked, but even among his men it was not low enough to indicate a definite state of chlorosis or anæmia.

The color index, or hæmoglobin quotient, indicating the richness in hæmoglobin of the individual red cells, is set by most authors at a normal of 1, this figure being based on an average erythrocyte count of 5,000,000 and an average hæmoglobin estimation of 100 per cent. Bearing in mind the evidence adduced in the above paragraphs, namely that the red cell counts of young men range above 5,000,000 and that the hæmoglobin reading commonly does not reach as high as 100 per cent, it becomes obvious that color indices as great as unity are not to be expected in most instances. However, we have not been able to find in Manila any statistics showing the mean index for healthy and vigorous young adults in the United States or Europe. It seems probable that average hæmoglobin quotients between 0.82 and 0.88 such as were found in our examinations, may be a little low, but not sufficiently so to be considered as definite indications of anæmia or chlorosis. We feel sure that such reduction in the hæmoglobin quotient as did occur among the men considered in Table III is not due to a prevalence of mild uncinariasis, since the stools of these men were examined at the conclusion of the observation period and only 2.3 per cent were found to contain hookworm eggs.

As regards the influence on the blood of the use of garments designed to absorb the actinic rays of the sun, it was shown in a former report of the Board(5) that the number of erythrocytes and the percentage of hæmoglobin were constantly a little higher for the men wearing orange-red underclothing than for those wearing white. This difference was thought to be due to concentration of the blood in those persons wearing the orange-red underwear, which was warmer than the white and therefore caused more profuse perspiration. As regards complexion type another report of the Board(6) showed that there was no constant or appreciable difference between the red cell counts and the hæmoglobin estimations of blond and brunette American soldiers who had served continuously in the Philippines for periods ranging from eighteen to twenty-four months.

In closing we wish to express our obligations to the medical officers referred to in footnote 3, who assisted the Board in making the hæmatologic examinations on which this report is based.

CONCLUSIONS.

From our own work it may be concluded that, after about twenty months of Philippine service, healthy American soldiers, living near sea-level and averaging 26 years of age, will show:

1. A red cell count averaging 5,200,000 per cubic millimeter, and rarely falling below 4,500,000.

2. A hæmoglobin reading averaging 89.6 per cent, and rarely falling below 85 per cent.

3. A color index averaging 0.86 or 0.87.

Such a red cell count does not differ from the normal at present recognized for healthy young men in the temperate zone. The hæmoglobin percentage and the color index are probably a little low, but not sufficiently so to indicate a definite anæmia. The pallor not infrequently met with among apparently healthy persons in the Tropics we believe to be due as a rule to superficial ischæmia and not to a deficiency in the total quantity, or in any particular constituent, of the blood.

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THE OCCURRENCE IN THE PHILIPPINES OF ASSOCIATED SPIROCHÆTÆ AND FUSIFORM BACILLI IN ULCERS OF THE THROAT (VINCENT'S ANGINA), OF THE MOUTH, AND OF THE SKIN, AND IN LESIONS OF THE LUNGS (BRONCHIAL SPIROCHÆTOSIS).[1]

By Weston P. Chamberlain.[2]

(*From the United States Army Board for the Study of Tropical Diseases.*)

In our quarterly report of March 31, 1910,(1) we referred briefly to the finding of several cases of the so-called Vincent's angina in the Philippines, and subsequently Bloombergh,(2) then a member of the Board, reported more fully on the subject. Since that time we have been on the lookout for the presence of Vincent's symbiotic organisms in all throat lesions coming to the notice of the Board and a large number of cases have been detected.

In 1894 Plaut(3) and in 1896 Vincent(4) called attention to a fusiform bacillus, commonly associated with a spirillum, in ulcerative lesions of the throat, pharynx, and mouth. Since that time many writers have confirmed these observations and the two organisms have been found in various other kinds of lesions. Weaver and Tunnicliff(5) have demonstrated the organism in noma and others have found them in ulcerative stomatitis, diphtheria, carious teeth, hospital gangrene, appendicitis, brain abscess, fœtid bronchitis, pyorrhœa alveolaris, and syphilitic lesions. Vincent,(10) Smith and Peil,(10) Bruce,(7) and ourselves(8) have met with similar forms in ulcerations of the skin. Recently Peters in Cincinnati has reported a case of fatal lobar pneumonia, a case of fœtid bronchitis and a case of septic infection of the hand, in all 3 of which fusiform bacilli and spirochætæ were present in large numbers in the exudate. In the case of hand infection the affected member had been injured by the teeth of another person. Hultgen(12) reports a similar case of hand infection where the patient had the nail-biting habit and the same organisms were found about the teeth.

Bacillus fusiformis of Plaut and Vincent is about 10 μ in length, the limits of size generally being set at 3 and 15 μ. Occasionally much larger ones have been seen by us. From the center the bacillus tapers toward the ends which are

[1] Published with permission of the Chief Surgeon, Philippines Division.

[2] Weston P. Chamberlain, major, Medical Corps, United States Army, president of the United States Army Board for the Study of Tropical Diseases as they Exist in the Philippine Islands.

sometimes blunt and at other times sharp. The organisms may be straight or slightly curved and are frequently arranged in pairs, end to end. Occasionally wavy forms are seen. They stain readily with carbol-fuchsin, Loeffler's methylene-blue, or Giemsa's stain, and many show irregularity in the intensity of the staining which gives them a quite characteristic banded appearance. They are non-motile.

The spirilla or spirochætæ are longer than the bacilli, ranging from 15 to 50 μ in length, and are made up of a variable number of undulations, usually from 3 to 5. They are usually very slender and in fresh preparations are extremely active. With the ordinary aniline dyes they stain less intensely than do the fusiform bacilli and occasionally present a beaded appearance as is shown in one of the appended photomicrographs.

Although several attempts have been made to cultivate these organisms from lesions containing them in great numbers we have been uniformly unsuccessful. They have been grown in pure culture by Weaver and Tunnicliff(5)(9) on slants of ascitic agar (1–3) and by Peters on Dorset's egg medium, in both cases under anærobic conditions. Tunnicliff and some others consider that the fusiform bacillus and the spirochætæ are different forms of one organism. Some observers consider them to be protozoa.

In smears from oral and faucial ulcers the symbiotic organisms of Vincent's angina are usually associated with varying numbers of other bacteria, such as staphylococci, streptococci, and different species of bacilli, including the Klebs-Loeffler bacillus. Abel has found the organisms in normal mouths, and Gross in apparently healthy tonsils.(5) Some have suggested that to make a diagnosis of Vincent's angina the organisms should be present in preponderating numbers, as compared with other bacteria.(5) Such a distinction is unsatisfactory, but may be of some clinical use and will be to a certain extent adhered to in the following report.

PRESENCE OF THE ORGANISMS IN THROAT AND MOUTH LESIONS IN THE PHILIPPINES.

During the last two years we have examined all patients with throat and mouth lesions who came to our notice in Manila. There were 106 of these, and in the smears from 34 (32 per cent) the fusiform bacilli and spirochætæ of Vincent's angina were present in *preponderating numbers*. In 22 others (21 per cent) a few of these symbiotic organisms were found, so that in 53 per cent of the total 106 cases they were present to a greater or less extent. The pathologic conditions with which they were associated are shown in the following table.

TABLE I.—*Occurrence of spirochætæ and fusiform bacilli in throat and mouth lesions in the Philippines.*

Pathological condition.	Present in preponderating numbers.	Present in small numbers.	Absent.
Ulcers of tonsil, cause uncertain	16	9	8
Ulcers of tonsil, probably syphilitic	4	0	5
Ulcers of faucial pillars, probably syphilitic	0	0	3
Ulcers of gums (ulcerative stomatitis)	6	3	3
Ulcers of gums, probably syphilitic	1	0	0
Ulcer of cheek	0	0	1
Ulcer of soft palate, probably syphilitic	2	0	1
Ulcer of tongue, probably syphilitic	1	1	1
Membranes on tonsil, cause uncertain	2	4	6
Mucus patches, syphilitic	2	0	1
Chancre, tongue	0	0	1
Chancre, tonsil	0	0	1
Aphthous stomatitis	0	0	5
Diphtheria tonsilar	0	0	4
Tonsillitis, acute, follicular	3	5	6
Sprue	0	0	1
Carcinoma of soft palate	1	0	0
Total	[a]38	22	50

[a] The discrepancy between 38 in this column and the 34 positive cases found is due to the fact that 4 of the cases had positive lesions in two different localities in the throat or mouth.

It will be observed that the two organisms were present in preponderating numbers in a considerable variety of conditions, the number of positive findings being highest in ulcers of the gums and of the tonsils. Twenty-seven of the lesions tabulated by us were apparently syphilitic, 2 being primary, 2 tertiary and the remainder secondary, and in these luetic cases the organisms of Vincent were found in preponderating numbers in 10 and in small numbers in 1. In not all of these presumably specific cases was the diagnosis absolutely unassailable, but in some of those in which the fusiform bacilli and spirochætæ were demonstrated in large numbers the diagnosis of syphilis was as certain as one could wish, being confirmed by the finding of *Treponema pallidum*, by the presence of a positive Wasserman reaction, or by the existence of unmistakable physical signs outside of the mouth.

Fusiform bacilli and spirochætæ were not detected in any of the 4 cases where the Klebs-Loeffler bacilli were found by cultural methods. From 44 others of the 106 cases studied, cultures on blood serum were made with negative results as far as the diphtheria bacillus was concerned. Many of these lesions showed in smears the presence of large numbers of spirochætæ and fusiform bacilli. In some of them the local appearances were strongly suggestive of diphtheritic infection.

Nearly all of our positive cases were young adult males, for the most part American soldiers. A few throat lesions among Filipinos were examined. Only one of these had any of the organisms and in this lesion they were not present in preponderating numbers.

In the patients showing fusiform bacilli and spirochætæ in preponderating numbers the clinical appearances and symptoms were so variable that no diagnosis based on them could have been of value. As shown in the table the localities affected were diverse. The ulcers were covered with white exudate in 2 and with soft grayish membranes in 8 cases. Fever was present in 6 of the cases of throat involvement, dysphagia in 16 and prostration in 1. Of the lesions on the gums 3 were very painful and 2 were painless. Most of the cases were acute, but 7 were chronic, some having had ulcers for several months.

On the assumption that carious teeth might be the cause of the frequent presence of spirochætæ and fusiform bacilli in the mouth, an examination was made of the material from the interior of the carious teeth of 10 individuals. In the smears from 3 individuals an occasional spirochæta was found, but no fusiform bacilli were seen in any instance. We also examined a number of smears from apparently normal tonsils. Most of these were negative, but in some there were a few spirochætæ and very rarely a small fusiform bacillus.

PRESENCE OF THE ORGANISMS IN LESIONS OF THE SKIN IN THE TROPICS.

In speaking of tropical ulcer Castellani and Chalmers say:(10) "Vincent believes the affection (Ulcus tropicum) to be due to the association of spirochaetes and fusiform bacilli so frequently found in such ulcers. Vincent's observations have been confirmed by Smith and Peil in Sierra Leone, Patton in Aden, and many other observers in various parts of the tropics." In 1907 Shattuck(6) working in the Philippines reported that of 34 ulcers of the skin examined by him 5 contained spirochætæ in the exudate. He states that some resembled *Spirochæta refringens* and that others appeared intermediate between that organism and *Treponema pallidum*. He concluded that the spirochætæ were not of etiologic significance because of their absence in sections. He makes no mention of having found fusiform bacilli in the smears from the ulcers, but in his photomicrographs there are some large not very clearly defined, bacilli which somewhat resemble *Bacillus fusiformis*.

Howard(13) reports spirochætæ, generally in company with *Bacillus fusiformis*, to be common in various types of ulceration in Nyasaland, and states that in sections the spirochætæ can be seen spreading into the healthy tissue in advance of other micro-organisms. He also says they may be found in nearly all foul-smelling neglected ulcers.

In January, 1911, W. J. Bruce(7) reported under the title of "Zambesi Ulcer" a condition which he had not previously seen described. The lesions, as seen by Bruce, were generally situated below the knee and consisted of punched-out ulcers which healed after one or two weeks without the production of any constitutional symptoms. In the smears from the ulcers he invariably found in great numbers a spirillum and a large fusiform bacillus.

A little time before the receipt of this report of Bruce one of us found spirochætæ and fusiform bacilli in large numbers in an ulcerated area on the foot of a Filipino. This ulcer was thought to be due to yaws, and smears from it were stained for *Treponema pertenue*. No treponemata were detected, and no other organisms except delicate spirochætæ, ranging in length from 15 to 50 μ, and heavy fusiform bacilli the length of which varied from 5 to 10 μ. Photomicrographs of the organisms are appended. We were at once impressed by the resemblance of these parasites to those described as the cause of the so-called Vincent's angina. The fusiform bacilli were of the same size and presented the same barred appearance on staining. Many were identical with *Bacillus fusiformis* of Plaut and Vincent, but on the average the ends did not seem quite as sharp as those of the organisms found in throat lesions. The spirochætæ were rather longer than those observed in the mouth and fauces and did not seem to stain as intensely with cold carbol-fuchsin. They were very slender and had from 6 to 12 shallow undulations, but differed considerably among themselves in size and shape.

Unfortunately this patient passed from observation before these organisms were demonstrated. Consequently no cultures were made and no history was obtainable.

During the last two years we have examined smears from a large number of ulcers of the skin, but have not encountered these organisms on any other occasion. Doctor R. P. Strong and others in Manila inform us that they have not met with them in lesions of the integument. Recently Lieutenant Armin Mueller, Medical Corps, United States Army, stated that he has found several such cases at Camp Jossman near Iloilo, P. I.

BRONCHIAL SPIROCHÆTOSIS WITH AN OCCASIONAL FUSIFORM BACILLUS.

Bronchial spirochætosis was first described by Castellani in 1906 since which date numerous cases, both acute and chronic, have been reported by observers in various tropical countries. From the description given by Castellani and Chalmers in their Manual of Tropical Medicine it appears that most, it not all, of these diagnoses, have been made from the sputum examinations alone. In 1909 Phalen and Kilbourne(11) of this Board reported a case of pulmonary spirochætosis in a Filipino, but called attention to the fact that the causative relation of the spirochætæ to the disease was not proven. The report mentions that a few large bacilli were present, but does not state whether they

resembled *Bacillus fusiformis*. Recently, on re-examining smears from this case, we found a few perfectly typical fusiform bacilli; they had the characteristic barred appearance when stained.

In searching fresh sputa for yeast the Board recently found specimens from 2 patients which showed large numbers of actively motile spirochætæ. Both of these patients were Filipinos suffering from typhoid fever. Specimens of sputum from 32 other patients having cough with expectoration were examined and none contained spirochætæ except one which had an extremely few, thick, spiral organisms such as might easily have entered the sputum from around the necks of the teeth where such organisms are common. Of the 32 patients, 27 were Americans and 5 natives.

The histories of the 2 cases, the sputa of which contained spirochætæ, are given through the courtesy of Captains H. S. Hansell and C. L. Foster, Medical Corps, who had charge of the patients.

Case I.—Udasco, Private, 23rd Company Philippine Scouts, age 23. Service two years and eight months. Tribe, Ilocano. Admitted to hospital November 3, 1910. Family and previous history unknown. Bad cough for three weeks previous to admission, and slight expectoration. Noted no blood. Headache and fever but no chills. On admission to hospital patient appeared very ill. Pulse regular and normal. A few vesicles on back and chest. Râles heard over both lungs. Abdomen distended and typanitic. Liver and spleen not palpable. Subsequently spleen was found palpable. Patient ran an irregular febrile course for twenty days, followed by a period of ten days of continued high fever associated with abdominal distention and constipation (relapse?), since which time (twenty-six days) there have been several unaccountable elevations of temperature. The Widal reaction was negative November 4, 5, and 6, partial on November 7, and positive on November 8. Blood was negative for *Bacillus typhosus* on November 7. Stools and urine were only examined during convalescence when they were negative for typhoid bacilli. The condition of the patient gradually improved after the relapse, and the cough disappeared.

Eleven specimens of sputum obtained at intervals were negative for tubercle bacilli. Stools negative for amœbæ and for ova except *Tricocephalus dispar*. No malarial parasites were found. There was a slight leucocytosis ranging from 8,000 to 15,000. Differential counts showed nothing of importance, averaging; polymorphonuclears 61 per cent, small lymphocytes 36 per cent, large mononuclears 2 per cent, and eosinophiles 1 per cent. Urine during febrile period showed a trace of albumin and a few granular casts. Diazo reaction negative. Subsequently urine became normal.

On November 30 and on several succeeding days the sputum contained great numbers of spirochætæ. Prior to that no effort had been made to find them as will be explained below when referring to staining methods. The sputum was thin and watery containing a large number of small grayish flakes which consisted of masses of cocci, many kinds of bacilli, and a few epithelial cells and leucocytes. There was no blood and no bad odor.

After a lapse of over four weeks (December 31, 1910) the sputum, obtained on forced cough, was of the same flakey character as described above and contained numerous spirochætæ.

Case II.—Cassas, civilian employee, age 25. Tribe, Tagalog. Admitted to hospital October 31, 1910. Family history unknown. No previous illness. During last two months has had slight chills and fever at irregular intervals. Since shortly before entry had a cough with muco-purulent expectoration. Some headache, no diarrhœa. Fairly well nourished, nothing abnormal found on physical examination except fever which pursued a typical typhoid course for a period of twenty-seven days when the temperature became normal for one week since which time (three weeks) it has been subject to irregular and unaccountable elevations. The Widal reaction was partial November 1, and positive November 3. On November 1, *Bacillus typhosus* was obtained from a blood culture. On November 22 a stool culture for the same organism was positive.

This patient became very ill as his disease progressed. On November 4 he vomited a great deal. The spleen became palpable. Subsequently pulse became dicrotic and weak and tympanites developed. On November 14 complained of sore throat and a patch of exudate appeared on the left tonsil. This was negative for diphtheria and *did not show the spirochætæ and fusiform bacilli associated with Vincent's angina.* On November 17 the throat symptoms had disappeared. On November 20 patient was very weak and began to cough up bloody sputum. This bloody expectoration lasted for several days and was quite profuse. After the temperature reached normal the patient gradually improved and the cough disappeared.

In this case the blood was negative for malaria. The leucocytes ranged from 8,500 to 12,800. The differential count showed nothing of interest; polymorphonuclears 68 per cent, small lymphocytes 30 per cent, and large mononuclears 2 per cent. The urine during the height of the fever showed a trace of albumin and a few hyaline casts. The stools showed ova of *Tricocephalus dispar*, and *Cercomonas intestinalis*, but no amœbæ.

After the appearance of bloody sputum an examination on nine occasions was negative for tubercle bacilli and on one occasion an acid-fast bacillus shorter and thicker than the tubercle bacillus was found. This specimen was inoculated into a guinea pig and at the end of eight weeks the animal was alive and well. At autopsy it showed no indications of tuberculosis.

On one occasion motile amœbæ and a flagellate resembling a cercomonas were found in the sputum.

The character of the sputum was the same as in the preceding case except that it was blood-stained at times. It was found to contain large numbers of spirochætæ associated with many masses of bacilli and cocci. *An occasional large fusiform bacillus was seen.* The spirochætæ were found constantly present for a period of two weeks. After a lapse of nearly two weeks more (December 31, 1910), the patient meanwhile having greatly improved in condition and the blood having disappeared from the sputum, spirochætæ were still present in considerable numbers though not as numerous as at the time of the hæmorrhage. The sputum at this time, obtained only after forced coughing, was thin and watery with great numbers of the small, gray flakes described in Case I. There were no blood corpuscles.

The spirochætæ in both cases were similar in motility, shape and size, averaging about 15 μ in length. They were thin and delicate and resembled the third class described by Castellani except that none having one blunt point were noticed.(10) In one of the patients (Number II) there were found a *few fusiform bacilli* similar to those which are seen

in symbiosis with spirochætæ in the so-called Vincent's angina. It is interesting to note that in history, symptoms, and character of the sputum these two cases were almost identical except that one contained fusiform bacilli and the other did not. Whether the presence of a few fusiform bacilli in one of these sputa, and in the sputum formerly described by Phalen and Kilbourne, was due to a contamination of the phlegm while it was passing through the mouth can not be determined. It is certain that the bacilli were present in both sputa in much smaller relative numbers than is usually the case in ulcers of the mouth and fauces when the symbiotic bacilli and spirochætæ are encountered.

In many of the cases described in the literature spirochætosis appears to be an independent disease. In considering the two histories recorded above it must be remembered that both patients were very ill with typhoid fever and, therefore, the presence of the organisms in the bronchial secretion may have been due simply to a migration downward, in a debilitated individual, of the spirochætæ which normally have a limited habitat in the mouth. However, the persistence of the spirochætæ in the sputum far into convalescence seems to be opposed to this view of the matter.

PREVALENCE OF SPIROCHÆTÆ AND FUSIFORM BACILLI IN LESIONS OCCURRING IN NON-TROPICAL COUNTRIES.

These associated organisms are probably much more common in oral and faucial lesions than is generally thought to be the case and would doubtless be very frequently met with if the practice of examining smears from ulcers in those regions was more general.

Rodella found the two organisms present in about one third of the 2,000 cases of pseudo-membraneous anginas which he examined.(5) Beitzke demonstrated the organisms in 5 out of 58 patients suspected of having diphtheria. Lublowitz reports the presence of fusiform bacilli in 6 out of 38 ulcers of the mouth. Arnold found the two organisms in 3 out of 5 cases of follicular tonsilitis.

Rothwell(14) under the title of "Bronchial Vincent's Angina" reports 4 cases, which have come to his notice in Missouri, where the sputum was swarming with fusiform bacilli and spirochætæ. There was bloody expectoration and the symptoms somewhat resembled asthma. Cases of fœtid bronchitis and pneumonia have been reported in which the sputum contained these 2 organisms, but as yet the reports of pulmonary cases in temperate regions are so few that no reliable estimate can be made as to the real frequency of the condition.

It is not improbable that the organisms may go undetected more commonly than is generally supposed to be the case because of the fact that a majority of the sputa examined microscopically are stained by Gabbett's method or some similar procedure. While the spiral organisms in pulmonary spirochætosis stain well with ordinary aniline dyes, such as carbol-fuchsin or Loeffler's methylene-blue, we found that

they were not acid fast and that *they did not stain with the sulphuric-acid-methylene-blue as ordinarily used in Gabbett's method for demonstrating tubercle bacilli.* The same was found to be true for the spirochætæ in Vincent's angina. Therefore, it is evident that spirochætæ in the sputum would be likely to be overlooked in making a routine examination of the sputum for tubercle bacilli.

The occurrence of the organisms in infections of the skin in temperate regions up to the present time has been reported but rarely and no estimate can be formed as to the frequency of such lesions. The cases reported by Peters and Hultgen are referred to in the second paragraph of this article.

CONCLUSIONS.

From our limited series of observations it appears probable that more than one-half of the throat and mouth ulcers one is likely to encounter in the Philippines will show fusiform bacilli and spirochætæ in greater or less numbers, and that one-third of the cases will have them in preponderating numbers. This is a somewhat higher rate than we have ever seen reported in temperate climates. However, it must be remembered that in all of the cases examined we were on the lookout for these particular parasites. The associated spirochætæ and fusiform bacilli have been found in an ulcer of the skin and in 2 cases of pulmonary disease, but as yet there is no evidence to show that in the Philippines they are common in these situations.

One caution needs to be given. In our opinion the finding of fusiform bacilli and spirochætæ in a throat lesion does not justify one in resting content with a diagnosis of "Vincent's Angina." Experience shows that syphilis, diphtheria, carcinoma, (and very probably other etiologic factors) must be carefully ruled out. It is still an open question whether the associated fusiform bacilli and spirochætæ are ever causative of the multiform lesions in which they are so often found to be present.

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ILLUSTRATIONS.

PLATE I.

FIGS. 1 and 2. Spirochætæ and fusiform bacilli in smears from an ulcer of the tonsil.

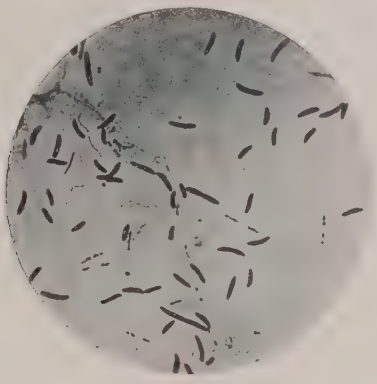
FIG. 3. Spirochætæ and fusiform bacilli in a smear from an ulcer of the tonsil, showing beaded staining.

PLATE II.

FIG. 4. Spirochætæ and fusiform bacilli in a smear from an ulcer of the gums.

FIGS. 5 and 6. Spirochætæ and fusiform bacilli in smears from an ulcer of the foot.

Magnification in all figures 1,000 diameters. Photomicrographs by Mr. Charles Martin of the Bureau of Science, Manila.



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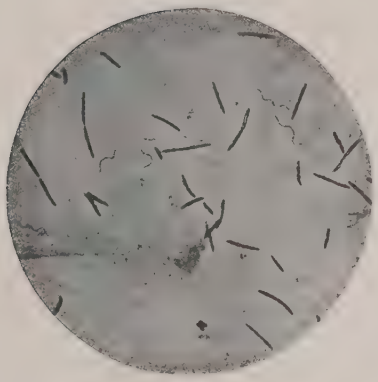

Fig. 2.

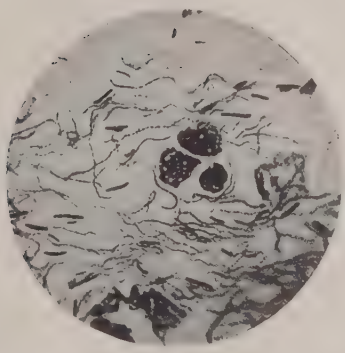

Fig. 3.

PLATE I.

Fig. 4.

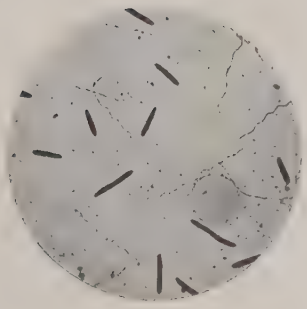

Fig. 5.

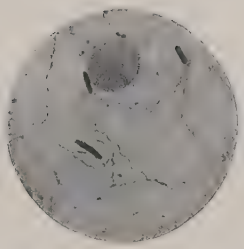

Fig. 6.

PLATE II.

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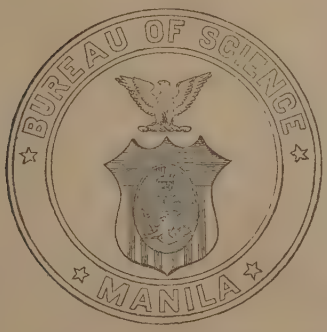

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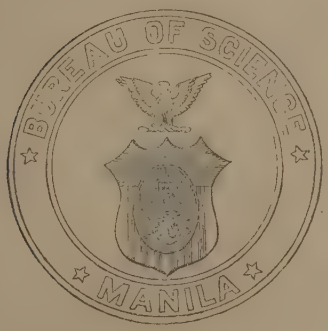

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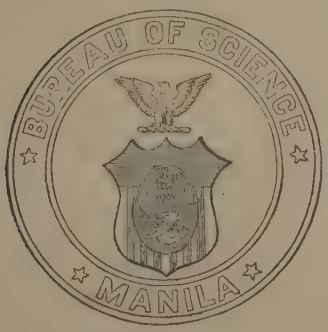

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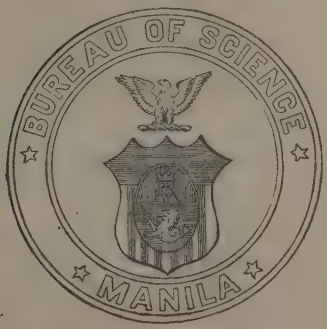

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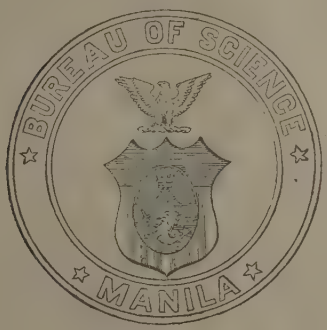

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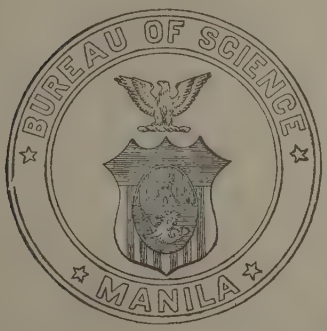

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